IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

HALLIBURTON ENERGY SERVICES, INC.,	§	
	§	
Plaintiff,	§	
	§	
vs.	§	C.A. NO. 3:02-CV-1347-P
	§	
WEATHERFORD INTERNATIONAL, INC. and BJ SERVICES COMPANY,	§	Jury Demanded
	§	
Defendants.	§	

BJ SERVICES COMPANY'S RESPONSE TO HES'S MOTION TO STRIKE

By filing its Motion to Strike, HES attempts, at the very earliest stages of the litigation, to impose a trial-ready standard on Defendants' evidence, while itself relying on the same type of evidence to argue it is entitled to the onerous remedy of a preliminary injunction. That the case is in its infancy and the time allowed for the parties to marshal their evidence has been short,[1] are reasons the Fifth Circuit has held that the preliminary injunction process necessitates less formal proceeding and evidentiary requirements.[2] *Federal Savings & Loan Ins. Corp. v. Dixon*, 835 F.2d 554, 558-59 (5th Cir. 1987) (citing *University of Texas v. Comenisch*, 451 U.S. 390, 395 (1981)). For example, "the district court may rely on otherwise inadmissible evidence, including hearsay evidence" and "can accept evidence in the form of deposition transcripts and affidavits." *Sierra Club*

[1] BJ had approximately five business days to prepare its opposition and supporting declarations.

[2] Although Federal Circuit law controls the substantive issues of a whether a preliminary injunction should issue in a patent case, *see Reebok Int'l Ltd. v. J. Baker, Inc.*, 32 F.3d 1552, 1555 (Fed. Cir. 1994), the law of the regional circuit controls the procedural aspects of injunctions. *Xeta, Inc. v. Aletx, Inc.*, 852 F.2d 1280, 1282 (Fed. Cir. 1988).

v. F.D.I.C., 992 F.2d 545, 551 (5th Cir. 1993).

CONCLUSION

HES's Motion to Strike should be denied.

Respectfully submitted,

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Sep-03-2002 05:04p

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of BJ Services Company's Response to HES's Motion to Strike has been served upon the following counsel of record via facsimile and First Class Mail, on Sept. 3, 2002.

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IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

HALLIBURTON ENERGY SERVICES, INC., Plaintiff, v. WEATHERFORD INTERNATIONAL, INC. and BJ SERVICES COMPANY, Defendants.	CIVIL ACTION NO. 02-CV-1347-N Jury Demanded

MOTION TO STRIKE HALLIBURTON'S CONSOLIDATED RESPONSE TO DEFENDANTS' SUR-REPLIES OR, ALTERNATIVELY, MOTION FOR LEAVE TO FILE A REPLY BRIEF

Defendant Weatherford International, Inc. ("Weatherford") files this Motion to Strike Halliburton's Consolidated Response to Defendants' Sur-Replies or, alternatively, Motion For Leave To File a Reply Brief and would respectfully show the Court the following:

I. INTRODUCTION AND SUMMARY

Halliburton's most recent "consolidated" brief marks the second straight time that Halliburton has exceeded the applicable page limit without seeking leave from the Court to do so. Apart from the fact that Halliburton has unilaterally ignored the Court's orders, Halliburton's tactics have skewed a process that is supposed to be orderly, efficient, and fair. Instead of filing successively narrower briefs and focusing the issues, as contemplated by the Court's rules and orders, Halliburton's briefing has progressively expanded in length and scope. Halliburton's consolidated response includes new arguments and evidence, as well as new twists on old arguments. Asserting such new material at this late stage is improper, prejudicial, and

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fundamentally unfair, particularly in light of the equitable nature of the relief that Halliburton seeks.

II. HALLIBURTON'S CONSOLIDATED RESPONSE SHOULD BE STRICKEN

Halliburton's "consolidated" response to Defendants' sur-replies should be stricken because it violates the Court's August 12, 2002 order and is prejudicial. This conclusion becomes even more apparent when viewed in the context of the entire course of Halliburton's preliminary injunction briefing and in light of the equitable relief it seeks.

A. Halliburton's 37-Page "Consolidated" Reply Brief Violated The Court's Local Rules And Asserted New Arguments and Evidence Without Justification.

Halliburton filed suit on June 27, 2002. In support of its motions for a TRO and preliminary injunction, Halliburton initially filed a consolidated 25-page brief. This brief complied with the Court's Local Rules on page limits. *See* LR7.2(c). Unfortunately, it was the last of Halliburton's preliminary injunction briefs to do so. Defendants filed their responses to Halliburton's motions on July 8, 2002.

Almost a month later, Halliburton filed its 37-page "consolidated" reply brief in violation of the Court's 10-page limit on such briefs. *See* LR7.2(c). Halliburton's brief included substantial new argument and evidence, including the transcript of Monty Harris's interview by Halliburton's counsel.[1] Although Halliburton stated that its consolidated brief was in response to four briefs filed by Defendants, Halliburton did not explain why it ignored the Court's rule that any exception to the 10-page limit will be permitted only by leave of the Court—and "only for exceptional and compelling reasons." *Id.* In any event, by presuming to grant itself leave,

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[1] As Weatherford has noted in previous briefing, Halliburton had interviewed Mr. Harris over three months before filing suit, yet Halliburton withheld this evidence from its initial briefing.

Halliburton was able to increase substantially the number of pages available to assert new arguments and evidence and to embellish its initial arguments.

It is telling that Halliburton initially filed a 25-page consolidated brief, followed by a 37-page "consolidated" reply brief. Absent the Court's intervention, Weatherford had no right to respond to the new arguments and evidence in Halliburton's reply, which dwarfed its initial briefing. There is no justification for this backwards briefing strategy, since Halliburton knew precisely the arguments Weatherford would make from the parties' meetings over six months before Halliburton filed suit.

B. <u>Halliburton's 28-Page "Consolidated" Response Brief Violated The Court's August 12, 2002 Order And Improperly Asserts New Arguments and Evidence</u>.

Although the Court intervened to permit Weatherford to respond to Halliburton's consolidated reply brief, Halliburton simply resorted to the same tactic in the next round of briefing. Pursuant to a telephone conference with Judge Solis on Monday, August 12, 2002, Defendants were given until August 22, 2002 to file separate sur-reply briefs of up to 15 pages in length. The Court also permitted Halliburton to file *15-page "responses"* five days after receipt of Defendants' sur-replies. *See* Aug. 12, 2002 Order, Docket Entry 55.

Consistent with the Court's August 12th order, BJ Services filed its 5-page sur-reply brief on August 12, 2002, and Weatherford filed its 15-page sur-reply on August 22, 2002. On August 27, 2002, however, Halliburton filed its *28-page* "consolidated" response brief. The Court's order expressly states: "Halliburton will file its ***responses*** to the sur-replies [filed by the Defendants], if any, on or before August 27, 2002. Said ***responses shall not exceed fifteen (15) pages***." Docket Entry 55 (emphasis added). The Court's August 12th order does not state that a single, "consolidated" response brief will be allowed; instead, the order expressly requires "responses" that do not exceed fifteen pages. Halliburton's 28-page "consolidated" response to

09/04/2002

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

HALLIBURTON ENERGY SERVICES, INC., Plaintiff, v. WEATHERFORD INTERNATIONAL, INC. and BJ SERVICES COMPANY, Defendants.	CIVIL ACTION NO. 02-CV-1347-N Jury Demanded

WEATHERFORD'S RESPONSE TO HALLIBURTON'S MOTION TO STRIKE OR, IN THE ALTERNATIVE, MOTION TO STRIKE THE DECLARATIONS IN SUPPORT OF HALLIBURTON'S REQUESTS FOR PRELIMINARY RELIEF

Defendant Weatherford International, Inc. ("Weatherford") files this Response to Halliburton's Motion to Strike (the "Motion") or, in the alternative, Motion to Strike the Declarations in Support of Halliburton's Requests for Preliminary Relief and would respectfully show the Court the following:

I. WEATHERFORD'S RESPONSE TO HALLIBURTON'S MOTION TO STRIKE

A. Halliburton's Motion Ignores The Less Strict Evidentiary Standard Applicable In Preliminary Injunction Proceedings.

Halliburton's Motion ignores well-settled case law holding that the rules of evidence are applied less strictly during preliminary injunction proceedings than they are during summary judgment proceedings or at the final hearing of the cause. Because the procedures at the preliminary injunction stage are less formal, the court may rely on otherwise inadmissible evidence, including hearsay evidence. *See Sierra Club, Lone Star Chapter v. F.D.I.C.*, 992 F.2d 545, 551 (5th Cir. 1993); *Fed. Sav. & Loan Ins. Corp. v. Dixon*, 835 F.2d 554, 558-559 (5th Cir.

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one month to prepare), but then chose to raise this alleged evidence for the first time at the close of the briefing in this matter (almost two months after Weatherford initially raised its arguments).

C. Halliburton's Briefing Tactics Are Fatally Inconsistent With Its Request For Equitable Relief.

Weatherford regrets burdening the Court with this additional motion and briefing. However, Halliburton seeks a preliminary injunction that will shut down an entire product line, to the immediate and severe harm of Weatherford, its employees, and third party suppliers. Halliburton's tactics are inconsistent with its request for preliminary injunctive relief in two ways.

First, Halliburton's belated efforts to bolster its applications for preliminary injunctive relief serve instead to emphasize that Halliburton was not entitled to such relief when it filed its motions and that it has not met its burden of proof. Second, Halliburton's sandbagging and other maneuverings are improper, fundamentally unfair, and inconsistent with the notion that the Court should exercise its equitable powers in the circumstances of this case.

For all these reasons, Weatherford respectfully requests that the Court strike Halliburton's consolidated response to Defendants' sur-replies from the record. At a minimum, the Court should strike Halliburton's new evidence of an alleged ADR agreement (including the Declaration of Albert O. Cornelison, Jr.) as untimely.

III. MOTION FOR LEAVE TO FILE A REPLY IN THE ALTERNATIVE

If the Court denies Weatherford's Motion to Strike Halliburton's Consolidated Response to Defendants' Sur-Replies, Weatherford files this Motion For Leave To File A Reply Brief. Halliburton had months to prepare its initial papers seeking injunctive relief and almost a month to fashion its reply brief. Notwithstanding Halliburton's belated new evidence and new

Exhibit 2004

arguments, Halliburton's reply brief and consolidated response brief do not establish a basis for preliminary injunctive relief.

Nevertheless, given the exceptional nature of the relief Halliburton seeks and the immediate and severe harm it will cause to Defendants and third parties, Weatherford feels compelled to respond to at least some of the new arguments and new evidence asserted for the first time in Halliburton's consolidated response brief. To consider the requested preliminary injunctive relief without affording Weatherford such an opportunity would be fundamentally unfair. For these reasons, Weatherford should be granted leave to file a 10-page reply to Halliburton's 29-page consolidated response brief.

IV. RELIEF REQUESTED

For the foregoing reasons, Weatherford respectfully requests that the Court strike Halliburton's Consolidated Response to Defendants' Sur-Replies, and prays for such other and further relief to which it may be justly entitled.

Alternatively, if the Court denies Weatherford's motion to strike Halliburton's consolidated response, Weatherford prays that it be granted leave to file up to a ten (10) page reply brief, and for such other and further relief to which it may be justly entitled. For the Court's convenience, a copy of Weatherford's proposed reply brief is attached as Exhibit "A."

Dated: September 11, 2002.

Respectfully submitted,

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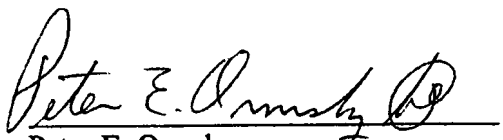
ATTORNEYS FOR DEFENDANT, WEATHERFORD INTERNATIONAL, INC.

Filed: 9/24/2002

CERTIFICATE OF CONFERENCE

I certify that I have conferred with counsel for all parties regarding Weatherford's motions. I discussed the motions with Halliburton's counsel, Ms. Renee Skinner, on September, 11, 2002, and Ms. Skinner stated that Halliburton opposes the motions. I discussed the motions with BJ Services Company's counsel, Ms. Jayme Partridge, on September 11, 2002, and Ms. Partridge stated that BJ Services Company does not oppose the motions.



Peter E. Ormsby

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing document has been served upon the following counsel of record via hand delivery and/or United States First Class Mail, on September 11, 2002.

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EXHIBIT "A"

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

HALLIBURTON ENERGY SERVICES, INC., Plaintiff, v. WEATHERFORD INTERNATIONAL, INC. and BJ SERVICES COMPANY, Defendants.	CIVIL ACTION NO. 02-CV-1347-N Jury Demanded

WEATHERFORD INTERNATIONAL, INC.'S REPLY TO HALLIBURTON'S CONSOLIDATED RESPONSE TO DEFENDANTS' SUR-REPLIES

Weatherford International, Inc. ("Weatherford") files this reply to Halliburton's consolidated response to Defendants' sur-replies (the "Response").

I. HALLIBURTON IS NOT ENTITLED TO PRELIMINARY RELIEF

Halliburton's 28-page Response includes new evidence and arguments that could have and should have been raised in earlier briefing. Halliburton's belated efforts to bolster its position serve to emphasize that this is not one of those exceptional cases in which preliminary injunctive relief is appropriate. *Polymer Technologies, Inc. v. Bridwell*, 103 F.3d 970, 977 (Fed. Cir. 1996) ("a preliminary injunction is a drastic and extraordinary remedy" that "must be thoroughly justified"). Yet, because the preliminary relief sought by Halliburton would cause immediate, severe harm to Weatherford and third parties, Weatherford is compelled to respond. Rather than addressing all of the errors in Halliburton's most recent brief,[1] this reply will focus on certain arguments that Halliburton either makes or elaborates upon for the first time.

1 For example, Halliburton continues to insist that corroboration of Mr. Harris's testimony is required. What Halliburton fails to note, however, is that the Federal Circuit law concerning the requirement for corroboration of testimony of prior public use is anything but settled. Specifically, the *Finnigan Corp. v. International Trade*

A. Weatherford Has Raised A Substantial Question Of Invalidity Of The Patents-In-Suit.

As the non-movant, Weatherford must only raise a substantial question of invalidity *or* noninfringement[2] to prevail at the preliminary injunction stage. *See New England Braiding Co. v. A.W. Chesterton Co.*, 970 F.2d 878, 883 (Fed. Cir. 1992). Despite Halliburton's contentions to the contrary, the Baker fiberglass packers, the Western Co. 2-3/8" composite bridge plug, and United States Patent No. 1,684,266 (the "'266 patent") each, independent of one another, anticipate and, thus, invalidate the claims asserted against Weatherford in this matter.

1. The Baker Fiberglass Packers Constitute Anticipatory Prior Art That Was Not Before The Examiner At The Patent And Trademark Office.

Halliburton attempts to diminish the importance of the Baker fiberglass packer by arguing (1) that it is no more relevant than other prior art that was before the patent examiner, and (2) that it is inapplicable because of the type of "slip means" it utilizes. The evidence of record contradicts Halliburton's positions.

a. The Baker Fiberglass Packer Is More Relevant Than The Prior Art The Patent Examiner Reviewed.

Halliburton claims in its Response that the Baker fiberglass packer is no more relevant than other prior art the Patent Office considered while examining the applications for the '468 and

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Comm'n, 180 F.3d 1354 (Fed. Cir. 1999) case cited by Halliburton specifically did not overturn *Thomson S.A. v. Quixote Corp.*, 166 F.3d 1172 (Fed. Cir. 1999). *Thomson* holds that corroboration is not required unless the testifying inventor is "a named party, an employee of or assignor to a named party, or otherwise is in a position where he or she stands to directly and substantially gain by his or her [testimony concerning the prior public use]." Indeed, the *Finnigan* panel could not overturn the holding in *Thomson*. *See Schroeder v. West*, 212 F.3d 1265, 1271 (Fed. Cir. 2000) ("[O]nly the Federal Circuit sitting en banc can overturn a prior panel decision.").

2 Halliburton again wrongly suggests in its Response that Weatherford does not contest infringement in this matter. *See* Response at 2. That is simply not the case, as Weatherford has repeatedly noted in its opposition briefs that it will also contest Halliburton's infringement allegations. Federal Circuit precedent states that an accused infringer must only raise a substantial question concerning invalidity *or* non-infringement to prevail at the preliminary injunction stage. The cases do ***not*** require the accused infringer to prevail on ***both*** invalidity and non-infringement. Given the limitations on the number of pages Weatherford had to contest validity and infringement, coupled with the fact that the Court has not construed the claims at this stage of the proceedings, Weatherford focused its arguments on the invalidity of the patents-in-suit. There are ***multiple*** terms in the patents-in-suit that must be construed. The construction of such disputed terms will provide the basis for Weatherford's non-infringement defenses.

'540 patents. This is not the case. No other prior art before the patent examiner was directed to a downhole tool made entirely of non-metallic components, including the slips and mandrel (i.e., the two components Halliburton relied upon to distinguish its claimed invention over the Sukup '202 patent to the Patent Office). This makes the Baker fiberglass packer reference more material than any other reference the patent examiner considered. *See, e.g., Semiconductor Energy Lab. Co. v. Samsung Elecs. Co.*, 204 F.3d 1368, 1374 (Fed. Cir. 2000) (determining materiality in the context of inequitable conduct and holding that "[a] withheld reference may be highly material when it discloses a more complete combination of relevant features, even if those features are before the patent examiner in other references").

Halliburton argues that the Baker fiberglass packer is no more relevant to the patentability of the Halliburton patents than the Watson reference (U.S. Patent No. 4,858,687, Response App. at **000677-681**), a prior art reference reviewed by the patent examiner. *See* Response at 11. This is clearly wrong. Even a cursory review of the Watson reference reveals that it depicts a completely different system. The Watson reference is directed to a wiper plug – it has no slips and no packing element. Halliburton even argued to the patent office that Watson does not have a mandrel. *See* Aug. 18, 1992 Amend. at 7, Response App. at **000386** ("Further, Watson clearly does not show any kind of central mandrel . . . ."). During the prosecution of the '468 patent, the patent examiner rejected several claims based on the Watson reference. In response, Halliburton added claim elements that require slips to engage the well. *See id.* at **000381**. The Baker fiberglass packer has slips and a packing element designed for engaging the wellbore.[3] As such,

3 Halliburton still makes the unsupported argument that the Baker fiberglass packers were not designed for "locking, sealing engagement" with the wellbore. *See* Response at 10-12. The advertisement and Special Products Manual page for the fiberglass packers show, however, that the packers include an elastomeric element, slips, a slip support and a cone. The components are utilized to set the packers in the wellbore, wherein the tool grippingly and sealingly engages the wellbore. Moreover, Mr. Tapp's Declaration establishes that when the Baker fiberglass packers were used, they were "in sealing and gripping engagement with the casing within the wellbore." Tapp Decl. at ¶¶ 7-8, **App. at W000201**. The Baker fiberglass packers grippingly engage the wellbore such that the tool is set in

the Baker fiberglass packer is unquestionably more relevant than the Watson reference.

Without naming the references, Halliburton argues that the Patent Office's rejection of claims 78 and 81 during the application process for the '468 patent further demonstrates that the patent examiner reviewed prior art that was just as relevant as the Baker fiberglass packers. *See* Response at 9. The prosecution history of the '468 patent reveals that claims 78 and 81 were rejected based on the Miller reference (U.S. Patent No. 4,977,958, Response App. at **000682-689**), the Sainato reference (U.S. Patent No. 4,300,631, Response App. at **000643-647**) and the Allen reference (U.S. Patent No. 3,055,424, Response App. at **000604-605**). A review of these references shows that the Baker fiberglass packer is significantly more relevant to the claims of the '468 and '540 patents than any of these references. Specifically, the Miller reference discloses a filter for a downhole pump. It has no slips or anything that causes the tool to engage the wellbore. Response App. at **000687-688**. The Sainato reference discloses a packer for coal mines. Likewise, it has no slips to engage the wellbore. *Id.* at **000646-647**. The Allen reference is directed to a liner – a totally different application. *Id.* at **000605-606**. The Baker fiberglass packer unquestionably shows more features of the asserted claims of the '468 and '540 patents than any of these references.

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b. <u>Halliburton's Basis For Its Interpretation Of The Term "Slip Means" Is Flawed.</u>

Although Weatherford has addressed the issue of the "slip means" claim limitation previously, Weatherford briefly responds to Halliburton's new attack on the Baker fiberglass

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position and does not move within the wellbore – as the slips are designed to grip the wellbore and prevent movement of the packer within the casing. *See id.* Similarly, the Baker fiberglass packers sealingly engage the wellbore such that the tool seals with the wellbore when set in its downhole position – as the packing elements on the fiberglass packers are specifically designed to seal with the wellbore and prevent fluid from leaking between the packing elements and the casing. *See id.* Without providing any discussion of the meaning of the term "locking, sealing engagement," it is incomprehensible how Halliburton can claim that the Baker fiberglass packers did not "lockingly" and "sealingly" engage the casing when positioned in the wellbore.

packers based on Halliburton's determination that the claim is written using "means-plus-function" language. *See* Response at 15-16. Halliburton attacks the Baker fiberglass packers' viability as prior art by claiming, for the first time, that it is not relevant to the means-plus-function meaning of the "slip means" element of certain of Halliburton's claims. Halliburton essentially argues that because these claims are written in means-plus-function format, the Baker fiberglass packer *must* include the *identical structure* disclosed in the Halliburton patents to qualify as invalidating prior art. First, Halliburton has failed to coherently explain why the claim would be subject to the means-plus-function provisions of the patent laws. Second, Halliburton's analysis under the means-plus-function statute is incorrect.

Halliburton merely concludes that the term "slip means" is part of a claim written in means-plus-function language without providing any analysis.[4] Even assuming, *arguendo*, that the claim is written in means-plus-function language, then Halliburton is clearly wrong when it claims that "slip means" requires that an invalidating reference contain *precisely* the same structure disclosed in the specifications of Halliburton's patents. The Federal Circuit has made it clear that Halliburton's methodology is wrong. In the context of means-plus-function claims, invalidating prior art can disclose *either* the particular recited structure *or an equivalent thereof*.

4 Weatherford does not concede that the "slip means" claim is written in means-plus-function language. The use of the word "means" gives rise to "a presumption that the inventor used the term advisedly to invoke the statutory mandates for means-plus-function clauses." *Sage Prods., Inc. v. Devon Indus., Inc.*, 126 F.3d 1420, 1427 (Fed. Cir. 1997) (quoting *York Prods., Inc. v. Central Tractor Farm & Family Ctr.*, 99 F.3d 1568, 1574 (Fed. Cir. 1996)). However, contrary to Halliburton's briefing, the presumption is not conclusive. *Id.* Where a claim recites a function, but then goes on to elaborate sufficient structure, material, or acts within the claim itself to perform entirely the recited function, the claim is not in means-plus-function format. *Id.* at 1427-28. For example, the presumption that 35 U.S.C. sec. 112, paragraph 6 has been invoked may be rebutted due to the fact that the term "slip" is a structurally definite term that is linked to a specific structural body (namely, a triangular component comprising jagged teeth for gripping the well bore). The recital of structure in claim 30 of the '468 patent "conflicts with the statutory requirement that means-plus-function claim elements state a function 'without the recital of structure.'" *See Envirco Corp. v. Clestra Cleanroom, Inc.*, 209 F.3d 1360, 1365 (Fed. Cir. 2000) (quoting 35 U.S.C. § 112, ¶ 6). Further, claim 30 of the '468 patent also recites the location of this structural feature ("disposed on said mandrel"). The Federal Circuit noted in *Cole v. Kimberly-Clark*, 102 F.3d 524, 531 (Fed. Cir. 1996) that the addition of the location of the structural term only helped to rebut the presumption that the claim is a means-plus-function claim.

In re Donaldson Co., 16 F.3d 1189, 1193 (Fed. Cir. 1994). The Baker fiberglass packer has a "slip support" or an *equivalent* means that performs the same function of "supporting" the slips on the mandrel and, thus, has a "slip means" for engaging the wellbore. Accordingly, even if the claims are written using a means-plus-function limitation, the Baker fiberglass packer remains an obstacle to granting a preliminary injunction.

2. **Halliburton's Arguments Based On The Alleged Commercial Success Of Its Patented Product Are Irrelevant.**

In its Response, Halliburton now accuses Weatherford of "ignoring" and "turning a blind eye" to Halliburton's alleged evidence of non-obviousness. *See* Response at 7-8. Not only is Halliburton's argument completely misguided, it misstates Weatherford's arguments presented in its opposition briefs. First, it is apparent Halliburton has attempted to blur the line between an invalidity challenge based on anticipatory prior art under 35 U.S.C. § 102 (a)-(b) and an invalidity challenge based on obviousness grounds under 35 U.S.C. § 103. Halliburton obviously wants to blur the distinction between these invalidity arguments to avoid the anticipatory nature of the asserted prior art and to make its position appear stronger. The fact remains, however, that Halliburton's alleged evidence of non-obviousness is irrelevant to a validity analysis under 35 U.S.C. § 102(a) or (b).

Second, Halliburton's assertion that in previous briefing, Weatherford "vigorously contended" that Halliburton's patent claims are obvious and that, *in response*, Halliburton put forward its alleged evidence of non-obviousness is inaccurate. Halliburton offered its alleged evidence of non-obviousness in its initial brief in support of its requests for preliminary relief. Weatherford did not attack this alleged evidence in its opposition briefs because, despite Halliburton's assertion to the contrary, Weatherford has always "concentrated" its invalidity arguments on the anticipatory nature of the asserted prior art and, as noted above, Halliburton's

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alleged evidence is irrelevant to such arguments.[5] Accordingly, Halliburton's arguments are misguided and do not overcome the anticipatory nature of the asserted prior art.

3. <u>The '266 Patent Anticipates The Claims Asserted Against Weatherford.</u>

Halliburton offers almost no argument in response to the prior art '266 patent asserted by Weatherford. What little argument Halliburton does offer is unsupported and contradicts the plain language of the '266 patent's specification and claims. For example, Halliburton makes the argument that the downhole tool disclosed in the '266 patent does not "sealingly engage the wellbore" and "cannot seal the wellbore." *See* Response at 21. This argument is completely contradicted by the plain language of the patent, which states:

> A further object of the invention is to provide an improved bridging plug carrying a ***sealing device*** which will ***engage*** the interior of the well casing and effectively form a packer or seal between the body of the plug and the casing to prevent leakage. . . . The rubber rings 22 also engage the casing and are compressed, thus forming a packer or seal to prevent the leakage of fluid between the exterior surface of the segments 10 and the casing.

Appendix to Weatherford's Sur-Reply at **W000213-214**, lns. 30-35, 68-73 (emphasis added).

Similarly, Halliburton makes the unsupported argument that the downhole tool disclosed in the '266 patent "lacks slip means." *See* Response at 21. Again, this argument ignores the fact that the '266 patent discloses a downhole tool with a plurality of slips supported on the mandrel, a tapered, wooden component utilized as a "cone" that "wedges the slips" into engagement with the wellbore and, thus, contains "slip means[6] being at least partially made of a non-metallic material." *Refer to* Weatherford's Sur-Reply at 8-10 and Claim Charts in the App. at **W000209-211**.

---

5 Weatherford has also asserted that the claims of the patents-in-suit are obvious in light of the asserted prior art. Nothing herein shall be construed as a waiver of Weatherford's obviousness arguments. However, Weatherford's asserted prior art provides, first and foremost, anticipatory references to each of the asserted claims and, thus, Weatherford has focused its invalidity arguments on 35 U.S.C. § 102(a)-(b).

6 Weatherford is not conceding to any claim constructions and reserves the right to challenge the meaning of disputed claim elements at a *Markman* hearing before this Court.

Additionally, Halliburton argues that the '266 patent does not disclose slips or sealing elements disposed on the mandrel, but rather disposed on the "segments" surrounding the mandrel. *See* Response at 22. Virtually the same Halliburton argument was rejected by the patent examiner during the prosecution of the parent application of the '468 patent. In responding to a rejection by the examiner, Halliburton argued that the Sukup '202 patent did not disclose packing elements disposed on the mandrel because the packing elements were disposed on "sleeves" that were between the mandrel and the packing elements. *See* Jan. 7, 1991 Amend. at 6, Response App. at **000565**. The patent examiner rejected Halliburton's argument, noting that "the seals are indirectly disposed on the mandrel . . .." Mar. 18, 1991 Office Action at 5, Response App. at **000575**. Similarly, the '266 patent discloses seals and slips that are "disposed on" the mandrel, and the '266 patent anticipates and invalidates the "claimed invention" of the asserted claims (as shown in the claim charts attached in the Appendix to Weatherford's sur-reply brief at pages **W000209-211**).

B. <u>Halliburton's New Evidence and Arguments Fail To Show Irreparable Harm.</u>

Weatherford has shown that Halliburton cannot seriously claim irreparable harm based on Weatherford's recent sales of composite tools when for years Halliburton has tolerated a higher volume of sales of composite tools by Baker Oil Tools. In its consolidated response, Halliburton belatedly offers new evidence and a different explanation in attempting to reconcile its claim of irreparable harm with its conduct.

Weatherford's initial briefing demonstrated that Halliburton's failure to take legal action against Baker—its largest competitor—refutes Halliburton's claim of irreparable harm. This is because either 1) Halliburton granted Baker a license or 2) Halliburton has delayed years in enforcing its patent rights against Baker—both of which are incompatible with a patentee's right to exclude. Weatherford's TRO Opp. at 15-16. Halliburton responded by noting its "refusal to

grant licenses" and claiming the right to "pick off" one infringer at a time. Halliburton Reply at 27, 29. As Weatherford pointed out, however, Halliburton's position on the latter point makes no sense, given that Baker was openly selling its composite tools for several years before Weatherford entered the market. Weatherford's Sur-Reply at 13.

But now Halliburton has offered ***new evidence and a different explanation*** for its tolerance of Baker's alleged infringement. Based on the Declaration of Albert O. Cornelison, Halliburton's general counsel, Halliburton implies (but does not state) that it has not taken legal action against Baker with regard to the patents-in-suit because the two companies are parties to an ADR agreement that requires confidential resolution of patent disputes. It is unclear why Halliburton chose to omit this evidence from its earlier reply brief, which Halliburton had a month to prepare. Halliburton obviously knew about this arrangement but withheld it from earlier briefing on the same subject. Apart from this apparent sandbagging, there are at least two reasons why Halliburton's ADR agreement with Baker does not change the conclusion that irreparable harm is absent.

First, there is no indication that Halliburton has in fact asserted the ***patents-in-suit*** against Baker ***even under the ADR procedure***. In what appears to be intentionally ambiguous wording, Halliburton states only that there is a pending dispute under the ADR agreement "involving" (in some unexplained way) Baker's composite tools. Response at 27. Second, if Halliburton has contractually bargained away its patent rights by entering into an ADR agreement with its biggest competitor, this in itself is incompatible with the right to exclude granted by a patent and establishes the absence of irreparable harm.[7] *See Wang Labs. Inc. v. Mitsubishi Elec. Am. Inc.*, 29

7 For example, Halliburton has obviously relinquished its right to seek injunctive relief in a court of law. Assuming that Halliburton has even invoked the ADR procedure against Baker with regard to the patents-in-suit (which Halliburton avoids stating directly), the result of this procedure is that Baker has continued to sell its composite tools for years.

U.S.P.Q.2d 1481, 1500 (C.D. Calif. 1993) (irreparable harm is rebutted by acts that are incompatible with a patentee's right to exclude) (citing *T.J. Smith & Nephew, Ltd. v. Consolidated Med. Equip., Inc.*, 821 F.2d 646, 648 (Fed. Cir. 1987)).

Halliburton further attempts to blunt the significance of Baker's presence in the market by understating the length of time that Baker has been selling composite tools. In doing so, Halliburton ignores the testimony of Mr. Jordan, a former Baker employee, who stated that Baker introduced it composite tools in about mid-1997—a full five years before Halliburton filed suit against Weatherford. Weatherford's TRO Opp., **App. at WE14**. Halliburton's belated reliance on the March/April 1999 issue of *Drilling Contractor* is misplaced. To begin with, that article does not purport to date Baker's initial introduction of composite tools, but instead focuses on one product line. In any event, even accepting Halliburton's chronology, Baker was actively marketing its composite tools ***more than two years*** before Weatherford began sales of its composite tools, yet Halliburton failed to take any legal action against Baker (or bargained away its right to do so). Such conduct cannot be reconciled with Halliburton's irreparable harm claim here.

II. CONCLUSION

For the foregoing reasons, and for the reasons stated in Weatherford's oppositions and sur-reply to Halliburton's motions for preliminary relief, Halliburton's Motion for a Temporary Restraining Order and Motion for a Preliminary Injunction should be denied.

Respectfully submitted,

By: ______________________

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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing document has been served upon the following counsel of record via hand delivery and/or United States First Class Mail on September 11, 2002.

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IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

HALLIBURTON ENERGY SERVICES, INC., Plaintiff, v. WEATHERFORD INTERNATIONAL, INC. and BJ SERVICES COMPANY, Defendants.	CIVIL ACTION NO. 02-CV-1347-N Jury Demanded

ORDER

Before the Court is Plaintiff Halliburton Energy Services, Inc.'s Motion to Strike filed on August 27, 2002. Having considered the Motion, the Court finds that the Motion lacks merit.

IT IS THEREFORE ORDERED that Plaintiff Halliburton Energy Services, Inc.'s motion to strike is DENIED.

Alternatively, IT IS ORDERED that Weatherford's Motion to Strike the Declarations Offered In Support of Halliburton's Requests for Preliminary Relief is GRANTED, and the declarations offered in support of Plaintiff Halliburton Energy Services, Inc.'s requests for a Temporary Restraining Order and Preliminary Injunction are stricken from the record and shall not be considered for purposes of a ruling on Halliburton's requests for preliminary relief.

Signed this _____ day of _____, 2002 at Dallas, Texas.

_____
THE HONORABLE DAVID C. GODBEY
UNITES STATES DISTRICT JUDGE

Sep 25 2002 09:05

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

HALLIBURTON ENERGY SERVICES, INC., Plaintiff, v. WEATHERFORD INTERNATIONAL, INC. and BJ SERVICES COMPANY, Defendants.	CIVIL ACTION NO. 02-CV-1347-N Jury Demanded

WEATHERFORD'S RESPONSE TO HALLIBURTON'S MOTION TO STRIKE OR, IN THE ALTERNATIVE, MOTION TO STRIKE THE DECLARATIONS IN SUPPORT OF HALLIBURTON'S REQUESTS FOR PRELIMINARY RELIEF

Defendant Weatherford International, Inc. ("Weatherford") files this Response to Halliburton's Motion to Strike (the "Motion") or, in the alternative, Motion to Strike the Declarations in Support of Halliburton's Requests for Preliminary Relief and would respectfully show the Court the following:

I. WEATHERFORD'S RESPONSE TO HALLIBURTON'S MOTION TO STRIKE

A. Halliburton's Motion Ignores The Less Strict Evidentiary Standard Applicable In Preliminary Injunction Proceedings.

Halliburton's Motion ignores well-settled case law holding that the rules of evidence are applied less strictly during preliminary injunction proceedings than they are during summary judgment proceedings or at the final hearing of the cause. Because the procedures at the preliminary injunction stage are less formal, the court may rely on otherwise inadmissible evidence, including hearsay evidence. *See Sierra Club, Lone Star Chapter v. F.D.I.C.*, 992 F.2d 545, 551 (5th Cir. 1993); *Fed. Sav. & Loan Ins. Corp. v. Dixon*, 835 F.2d 554, 558-559 (5th Cir.

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1987).[1] The reason for this evidentiary leniency in the preliminary injunction stage is that such a restraining order or injunction is used when quick action is necessary. *Dixon*, 835 F.2d at 558; *see also Asseo v. Pan Am. Grain Co., Inc.*, 805 F.2d 23, 26 (1st Cir. 1986) (stating that "[a]ffidavits and other hearsay materials are often received in preliminary injunction proceedings. The dispositive question is not their classification as hearsay but whether, weighing all the attendant factors, *including the need for expedition*, this type of evidence was appropriate given the character and objectives of the injunctive proceeding" (emphasis added)).

This action presents the perfect case for the application of the relaxed evidentiary standard at the preliminary injunction stage, particularly with regard to Defendants' evidence. Halliburton had months to prepare its initial brief and supporting declarations and approximately one month to file its reply brief and supporting declarations. In contrast, Weatherford had only ten days (less than six business days after receiving Halliburton's pleading) to prepare and file its opposition briefs and supporting declarations. This expedited briefing schedule imposed on Weatherford is the type of time constraint that requires relaxed application of the evidentiary rules.

Halliburton's Motion fails to recognize the controlling case law that allows this Court to rely on otherwise inadmissible evidence, including hearsay evidence, at the preliminary injunction stage. Consistent with the cited authority, it is clearly proper for the Court to consider the Declarations of Monty Harris, William Tapp, Clyde E. Holt, and John McKeachnie submitted by Weatherford in this action.

FILED: 7 DEC 2005

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1 Because the evidentiary standard applicable at the preliminary injunction stage is a procedural matter, Fifth Circuit law is controlling on this issue. *See Payless Shoesource, Inc. v. Reebok Intern. Ltd.*, 998 F.2d 985, 987 (Fed. Cir. 1993) ("As a general rule, we review procedural matters under the law of the regional circuit in which the district court sits.")

B. **Halliburton's Motion To Strike Is Untimely.**

Additionally, Halliburton has waived its objections by failing to timely assert them. Specifically, with the exception of the Declaration of William Tapp, the declarations Halliburton objects to were submitted in support of Weatherford's opposition briefs filed on July 8, 2002. Despite having over four weeks to prepare its reply brief, Halliburton failed to object to Weatherford's declarations in its consolidated reply brief filed on August 6, 2002. Instead, Halliburton waited to file its Motion until after Weatherford had filed its sur-reply.

Halliburton has waived any objections to the declarations by failing to assert the objections *for almost two months*[2] and by waiting to assert them after Weatherford's sur-reply was filed. *See Hill v. Aurora National Life Assurance Co.*, 1999 WL 202548 *4, n.3 (N.D. Tex., March 30, 1999) (striking plaintiff's new arguments to defendant's summary judgment evidence raised in plaintiff's sur-reply brief and stating that "[p]laintiff's failure to timely raise these arguments left no opportunity to respond. Thus, these arguments are waived"). Accordingly, Halliburton's Motion should be denied.

II. MOTION TO STRIKE THE DECLARATIONS OFFERED IN SUPPORT OF HALLIBURTON'S REQUESTS FOR PRELIMINARY RELIEF IN THE ALTERNATIVE

If the Court grants Halliburton's Motion, Weatherford files this Motion to Strike the Declarations Offered In Support Of Halliburton's Requests for Preliminary Relief. By filing its Motion, Halliburton is attempting to hold Weatherford to a higher evidentiary standard than that which is applicable at this stage of the proceedings. Moreover, Halliburton is attempting to hold Weatherford to a higher evidentiary standard than that which is applied to Halliburton's own declarations. This is particularly inappropriate in this action because unlike the expedited

2 Weatherford's declarations were filed on July 8, 2002. Halliburton filed its Motion on August 27, 2002.

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briefing schedule Defendants faced, Halliburton took months to prepare and file its preliminary injunction papers. *See* Weatherford's TRO Opp. at 10-14.

As Weatherford's objections to Halliburton's declarations show, Halliburton's declarations contain the same purported "flaws" as those Halliburton asserts are found in Weatherford's declarations. *See* Objections to Halliburton's Declarations, Exhibit "A" attached hereto and incorporated herein. Specifically, Halliburton's declarations are replete with hearsay, statements that are not based on personal knowledge, statements based on speculation, and statements that assume facts not in evidence and/or in dispute.

If the Court chooses not to apply the relaxed evidentiary standard applicable in the preliminary injunction context, Weatherford respectfully requests that Halliburton's declarations be stricken as evidence in this matter for the reasons set forth in Exhibit A attached hereto. Further, if the Court grants Weatherford's motion to strike, Weatherford respectfully requests that the Court deny Halliburton's requests for preliminary relief, as Halliburton's requests would be unsupported by any evidence, and Halliburton could not meet its burden of proof.

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III. RELIEF REQUESTED

For the foregoing reasons, Weatherford respectfully requests that the Court deny Halliburton's Motion to Strike, and prays for such other and further relief to which it may be justly entitled.

Alternatively, if the Court grants Halliburton's Motion to Strike, Weatherford prays that the Court grant Weatherford's Motion to Strike the Declarations Offered In Support of Halliburton's Requests for Preliminary Relief, and prays for such other and further relief to which it may be justly entitled.

Dated: September 11, 2002.

Respectfully submitted,

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CERTIFICATE OF CONFERENCE

I certify that I have conferred with Halliburton's counsel, Ms. Renee Skinner, on September 11, 2002, and Ms. Skinner stated that Halliburton opposes Weatherford's alternative Motion to Strike the Declarations Offered In Support of Halliburton's Requests for Preliminary Relief. I also discussed the alternative motion to strike with counsel for BJ Services Company, Ms. Jayme Partridge, on September 11, 2002, and Ms. Partridge stated that BJ Services Company does not oppose the motion.

Peter E. Ormsby

Peter E. Ormsby

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing document has been served upon the following counsel of record via hand delivery and/or United States First Class Mail, on September 11, 2002.

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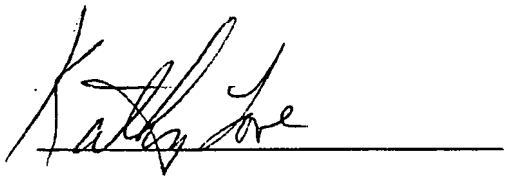

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EXHIBIT "A"

I. DECLARATION OF WESLEY JAY BURRIS, II

Weatherford makes the following objections to the declaration of Wesley Jay Burris, II:

a. With respect to the statement, "These Weatherford materials show that Weatherford is offering 'FracGuard' tools that ***appear*** to provide design features and advantages and are directly competitive with Halliburton's 'FAS Drill tools'" made at ¶ 18 (emphasis added), Weatherford makes the following objections:

The statement is based on speculation and does not affirmatively show that the declarant is competent or had the requisite personal knowledge to make the statement that Weatherford's tools are "directly competitive" with Halliburton's tools.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

b. With respect to the statement, "Halliburton's sales representatives report that Weatherford and BJ have attacked and continue to attack Halliburton's domestic market for 'FAS Drill' drillable bridge plugs and frac plugs, including its market for related products and services" made at ¶ 24, Weatherford makes the following objections:

The statement is hearsay and not based on personal knowledge.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

c. With respect to the statement, "Weatherford's and BJ's marketing and selling of their 'FracGuard' and 'Python' products is causing Halliburton to experience millions of dollars of lost sales within the United States of its 'FAS Drill' bridge plugs and frac plugs to Weatherford's and BJ's lower-priced products" made at ¶ 26, Weatherford makes the following objections:

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The statement is based on speculation (as it does not account for the effects of other competitors on Halliburton's sales and pricing) and assumes facts not in evidence and/or in dispute (as Weatherford has affirmatively shown that its products are often not lower-priced than Halliburton's products).

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

d. With respect to the statement, "Halliburton's markets within the United States have since experienced such price pressures from competitive offers of Weatherford's 'FracGuard' and BJ's 'Python' composite tools that Halliburton has been forced to increase its offered discounts . . ." made at ¶ 27, Weatherford makes the following objections:

The statement is based on speculation (as it does not account for the effects of other competitors on Halliburton's sales and pricing) and assumes facts not in evidence and/or in dispute (as Weatherford has affirmatively shown that its products are often not lower-priced than Halliburton's products).

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

e. With respect to the statement, "Halliburton expects it will face extreme opposition from its customers to any future attempts to raise prices" made at ¶ 28, Weatherford makes the following objections:

The statement is based on speculation and is not based on personal knowledge.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_________ OVERRULED

f. With respect to the statement, "Consequently, these price discounts may never be reversed" made at ¶ 28, Weatherford makes the following objections:

The statement is based on speculation and is not based on personal knowledge.

Court's ruling:

_________ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_________ OVERRULED

g. With respect to the statement, "Halliburton has lost and continues to lose customer goodwill due to the pricing differences between Halliburton's 'FAS Drill' tools and Weatherford's and BJ's lower-priced products" made at ¶ 29, Weatherford makes the following objections:

The statement is based on speculation (as it does not account for the effects of other competitors on Halliburton's sales, pricing and customer goodwill) and assumes facts not in evidence and/or in dispute (as Weatherford has affirmatively shown that its products are often not lower-priced than Halliburton's products).

Court's ruling:

_________ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_________ OVERRULED

h. With respect to the statement, "For example, in October 2001, a Halliburton technical advisor in the field advised Halliburton that in one case a customer was going to buy a Weatherford 'FracGuard' composite frac plug . . ." made at ¶ 31, Weatherford makes the following objections:

The statement is hearsay, is based on speculation, and is not based on personal knowledge.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

i. With respect to the statement, "Also in October 2001, Halliburton heard in the market that Weatherford was offering to potential customers a first plug free" made at ¶ 32, Weatherford makes the following objections:

The statement is hearsay, is based on speculation, and is not based on personal knowledge.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

j. With respect to the statement, "Halliburton has heard in the market that Weatherford has made a similar bid to another operator . . ." made at ¶ 33, Weatherford makes the following objections:

The statement is hearsay, is based on speculation, and is not based on personal knowledge.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

k. With respect to the statements, "Over the next few years, operators of newly-drilled wells will select service companies to perform well-completion services, and the operators will select the service companies based on their ability to supply composite drillable bridge plugs and frac plugs. Weatherford and BJ will use their 'FracGuard' [sic] and 'Python' composite tools to create customer relationships that would have been Halliburton's" made at ¶ 35, Weatherford makes the following objections:

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The statements are based on speculation, are not based on personal knowledge, and assume facts not in evidence and/or in dispute (as Weatherford has affirmatively shown that it does not compete with Halliburton for the collateral "well-completion services").

Court's ruling:

_________ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_________ OVERRULED

l. With respect to the statements, "Weatherford's and BJ's sales of competitive products to Halliburton's 'FAS Drill' products adversely affects sales of Halliburton's related products and services. Due to Weatherford's and BJ's marketing and sales of their 'FracGuard' and 'Python' tools, Halliburton has experienced a decline in the sale of products and well services that relate to the use of a drillable composite bridge plug and frac plug tool" made at ¶ 36, Weatherford makes the following objections:

The statements are based on speculation and assume facts not in evidence and/or in dispute (as Weatherford has affirmatively shown that it does not compete with Halliburton for sales of "related services").

Court's ruling:

_________ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_________ OVERRULED

m. With respect to the statement, "When the market returns to a growth phase, employees like these and their experience will be difficult to replace" made at ¶ 38, Weatherford makes the following objections:

The statement is based on speculation, is not based on personal knowledge, and assumes facts not in evidence and/or in dispute.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

n. With respect to the statements, "If Weatherford and BJ are allowed to continue marketing their 'FracGuard' and 'Python' products, I ***believe*** Halliburton's prices for its "FAS Drill" products will continue to be undercut, Halliburton will continue to lose market share for drillable tools, Halliburton will continue to lose sales of collateral products and services, and Halliburton will continue to lose goodwill in the market. Halliburton may never be able to recover its pricing structure. And I ***believe*** these losses would be difficult or impossible to quantify" made at ¶ 38, Weatherford makes the following objection:

The statements are based on speculation and impermissibly qualify the personal knowledge requirement.

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

o. With respect to the statement, "If Weatherford and BJ were enjoined from selling their 'FracGuard' and 'Python' products . . ., I ***believe*** that other downhole tool manufacturers and well-service providers would be discouraged from marketing, selling, and using such downhole tools . . ." made at ¶ 39, Weatherford makes the following objection:

The statement is based on speculation and impermissibly qualifies the personal knowledge requirement.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

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II. DECLARATION OF HAROLD E. MCGOWEN, III

Weatherford makes the following objections to the declaration of Harold McGowen, III:

a. With respect to the statements, "I talked to a person present in Weatherford's booth who wore a badge identifying himself as a representative of Weatherford. The representative showed me a physical example of a 'FracGuard' composite bridge plug . . ., he described the tool to me, and he answered my questions regarding its structure, operation, and component materials" made at ¶ 9, Weatherford makes the following objections:

The statements are hearsay and lack foundation/assume facts not in evidence (as there is no evidence that the ***unnamed*** "individual" was a Weatherford employee or had authority to speak on Weatherford's behalf).

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

b. With respect to the statements, ". . . including the representations made to me by Weatherford's representative . . ." and ". . . the Weatherford representative made certain representations to me about Weatherford's 'FracGuard' composite bridge plugs . . ." made at ¶¶ 10 and 11, Weatherford makes the following objections:

The statements lack foundation/assume facts not in evidence (as there is no evidence that the ***unnamed*** "individual" was a Weatherford employee or had authority to speak on Weatherford's behalf).

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

c. With respect to the statement, "The Weatherford representative confirmed that the 'FracGuard' tool is a drillable type bridge plug that can be drilled out of the well bore quickly" made at ¶ 11(a), Weatherford makes the following objections:

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The statement is hearsay and lacks foundation/assumes facts not in evidence (as there is no evidence that the ***unnamed*** "individual" was a Weatherford employee or had authority to speak on Weatherford's behalf).

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

d. With respect to the statements, "The Weatherford representative confirmed that Weatherford's 'FracGuard' tool has a center mandrel made of a non-metallic material" and other statements purportedly made by the alleged Weatherford representative made at ¶11(b), Weatherford makes the following objections:

The statements are hearsay and lack foundation/assume facts not in evidence (as there is no evidence that the ***unnamed*** "individual" was a Weatherford employee or had authority to speak on Weatherford's behalf).

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

e. With respect to the statement, "... the Weatherford representative confirmed that Weatherford's 'FracGuard' tool has a packing element on the tool designed to seal with the well bore" made at ¶11(c), Weatherford makes the following objections:

The statement is hearsay and lacks foundation/assumes facts not in evidence (as there is no evidence that the ***unnamed*** "individual" was a Weatherford employee or had authority to speak on Weatherford's behalf).

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

Exhibit 2 to 2/24/2005

_____ OVERRULED

f. With respect to the statements, "The Weatherford representative confirmed that the cone of both slips assemblies of Weatherford's 'FracGuard' tool is made of a non-metallic material" and other statements purportedly made by the alleged Weatherford representative made at ¶ 11(e), Weatherford makes the following objections:

The statements are hearsay and lack foundation/assume facts not in evidence (as there is no evidence that the ***unnamed*** "individual" was a Weatherford employee or had authority to speak on Weatherford's behalf).

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

III. SECOND DECLARATION OF WESLEY JAY BURRIS, II

Weatherford makes the following objections to the second declaration of Wesley Jay Burris, II:

a. With respect to the statement, "Weatherford's practice ***appears*** to be that it keeps the tools in its possession until the time of installation, and then it sends a company representative with the tool to supervise the tool's installation in the well bore" made at ¶ 3, Weatherford makes the following objections:

The statement is based on speculation and impermissibly qualifies the personal knowledge requirement.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

FILED - 2007 JUN 04

b. With respect to the statement, "***Like Weatherford***, BJ's practice ***appears*** to be that it keeps the tools in its possession until the time of installation, and then it sends a company representative with the tool to supervise the tool's installation in the well bore" made at ¶ 5 (emphasis added), Weatherford makes the following objections:

The statement is based on speculation and impermissibly qualifies the personal knowledge requirement.

Court's ruling:

_________ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_________ OVERRULED

IV. DECLARATION OF JONATHAN ORITZ

Weatherford makes the following objections to the declaration of Jonathon Ortiz:

a. With respect to the statement, "In the South Texas region, Weatherford and BJ focus their efforts on the market where Halliburton has developed and fostered a demand as well as proven the technology's effectiveness . . ." made at ¶ 6, Weatherford makes the following objections:

The statement is based on speculation and is not based on personal knowledge (as Mr. Ortiz is not competent to testify about how Weatherford "focuses" its sales efforts).

Court's ruling:

_________ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_________ OVERRULED

b. With respect to the statements, "***Upon information and belief***, on or about June 21, 2002, Weatherford sold 'FracGuard' 4 ½" high-pressure/high-temperature (HP/HT) composite plugs to El Paso for use in the treatment of Samano #32 (6 plugs). ***Upon information and belief***, on or about June 27, 2002, Weatherford sold 'FracGuard' 4 ½" high-pressure-high-temperature (HP/HT) composite plugs

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to El Paso for use in the treatment of Samano #31" made at ¶ 8 (emphasis added), Weatherford makes the following objections:

The statements are based on speculation and impermissibly qualify the personal knowledge requirement.

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

c. With respect to the statements, "If Weatherford is allowed to continue selling its 'FracGuard' tools that compete with Halliburton's FASDrill® tools, over the course of the rest of 2002 Halliburton will lose the opportunity to sell approximately 25-30 plugs for the estimated remaining 6 wells in El Paso Production's Samano Field. I ***anticipate*** the next lost sale in El Paso's Samano field will occur on or before July 20, 2002. The loses for the remainder of the year are expected to total about $280,000" made at ¶ 10 (emphasis added), Weatherford makes the following objections:

The statements are based on speculation and are not based on personal knowledge.

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

d. With respect to the statements, "Halliburton has lost and continues to lose customer goodwill in my region due to the pricing differences between Halliburton's 'FAS Drill' tools and Weatherford's and BJ's lower-priced products. The presence of Weatherford's and BJ's competing products is eroding Halliburton's market share of drillable tools in my region" made at ¶ 18, Weatherford makes the following objections:

The statements are based on speculation (as it does not account for the effects of other competitors on Halliburton's sales and pricing) and assume facts not in

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evidence and/or in dispute (as Weatherford has affirmatively shown that its products are often not lower-priced than Halliburton's products).

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

e. With respect to the statement, "***Upon information and belief***, Weatherford is offering potential customers a first plug free in my region" made at ¶ 17 (emphasis added), Weatherford makes the following objection:

The statement is based on speculation and impermissibly qualifies the personal knowledge requirement.

Court's ruling:

_____ SUSTAINED and the statement will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

f. With respect to the statements contained in paragraph 20, Weatherford makes the following objections:

The statements are based on speculation, are not based on personal knowledge, and assume facts not in evidence and/or in dispute.

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

V. DECLARATION OF ALBERT O. CORNELISON, JR.

Weatherford makes the following objections to the declaration of Albert O. Cornelison, Jr.:

a. With respect to the entire declaration, Weatherford objects to the submission of the declaration as untimely, as it raises new evidence for the first time in a response to a sur-reply brief. This new evidence is offered in response to arguments first made by Weatherford in its opposition briefs filed on July 8, 2002. Halliburton's failure to raise this alleged evidence in its consolidated reply brief, but instead raise it for the first time at the close of the briefing in this matter (almost two months after Weatherford initially raised its arguments), makes the submission of this declaration untimely.

Court's ruling:

_____ SUSTAINED and the declaration will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

b. With respect to the statements, "Currently there is more than one ongoing dispute with Baker Hughes that is covered by and is being resolved under the terms of the IPDRA. One currently active patent dispute concerns Baker Hughes's 'QUICK Drill' composite well tools" made at ¶ 4, Weatherford makes the following objection:

These statements are irrelevant. These statements are intentionally vague, as they do not actually state that Halliburton has ever asserted ***the patents-in-suit*** against Baker or that the alleged dispute concerning Baker's "QUICK Drill" composite tools involves ***the patents-in-suit***.

Court's ruling:

_____ SUSTAINED and the statements will not be considered by the Court in considering Halliburton's TRO and Preliminary Injunction Motions.

_____ OVERRULED

EXHIBIT 2004

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

HALLIBURTON ENERGY SERVICES, INC., Plaintiff, v. WEATHERFORD INTERNATIONAL, INC. and BJ SERVICES COMPANY, Defendants.	CIVIL ACTION NO. 02-CV-1347-N Jury Demanded

ORDER

Before the Court is Defendant Weatherford International, Inc.'s Motion to Strike Halliburton's Consolidated Response to Defendants' Sur-Replies or, Alternatively, Motion for Leave to File a Reply Brief in response to Halliburton's consolidated response brief filed on August 27, 2002.

Having considered the Motion, IT IS ORDERED that Halliburton Energy Services, Inc.'s Consolidated Response to Defendants' Sur-Replies is stricken from the pleadings in this case for failure to comply with the Court's August 12, 2002 Order.

Alternatively, IT IS ORDERED that Weatherford International, Inc. is permitted to file a reply brief in response to Plaintiff's consolidated response brief. Accordingly, Weatherford's proposed reply brief attached to the motion to strike shall be filed with the pleadings in this action for consideration by the Court.

Signed this _____ day of _____, 2002 at Dallas, Texas.

_____
THE HONORABLE DAVID C. GODBEY
UNITES STATES DISTRICT JUDGE

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FILED 2002 AUG 29 PM 4:05

Exhibit

Page 20 of 20006

#643329

OGILVY RENAULT

012

Montréal, November 5, 2002

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The Commissioner of Patents
Canadian Intellectual Property Office
Place du Portage
Hull, Quebec
CANADA K1A 0C9

Sir:

RE: PAYMENT OF GOVERNMENT FINAL FEE
Classification: 05E21B-00034/12
Our Ref.: 5059-598 SC/ip

A cheque in payment of the Government Final Fee of $300.00 is submitted herewith for the following application:

APPLICANT: HALLIBURTON COMPANY

SERIAL NUMBER: 2,071,721

FILING DATE: June 19, 1992

TITLE OF INVENTION: DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF

DATE OF ALLOWANCE: October 23, 2002

Applicant declares a Small Entity Status: ☐ YES ☒ NO

Please issue the patent in accordance with Sections 42 and 43 of the Patent Act.

The Commissioner is hereby authorized to charge payment of any deficiency in the enclosed fees to Deposit Account No. 600000257.

FAX RECEIVED NOV 5 2002

Barristers & Solicitors
Patent & Trade-Mark Agents

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Respectfully submitted,

OGILVY RENAULT

SC/ip

Encl. - cheque no. 59690 - $300.00

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File No.: 5059-598 RM/SC/ip

Montreal, Canada
September 11, 2002

IN THE CANADIAN INTELLECTUAL PROPERTY OFFICE

In re Application of: HALLIBURTON COMPANY

For: DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF

Serial No.: 2,071,721

Filed: June 19, 1992

Classification: E21B-34/12

Examiner: DABROWSKI, Edward

Agent: Robert Mitchell Tel.: (514) 845-7126

2 Industrie Canada OPIC Industry Canada CIPO 2
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Dossier File
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AMENDMENT

The Commissioner of Patents
Place du Portage
Hull, Quebec
CANADA K1A 0C9

Sir:

This is in response to the Official Action dated May 21, 2002.

Kindly amend the application in the following respects:

IN THE DISCLOSURE:

Kindly substitute the enclosed new pages 6 and 14 for corresponding pages 6 and 14 at present on file.

IN THE CLAIMS:

Kindly substitute the enclosed new set of claims, comprising claims 1 to 75, for the set of claims at present on file.

The Commissioner of Patents

Application No. 2,071,721

- REMARKS -

Claims 1 to 75 are now in the application.

Further to Applicant's submission of prior art, including United States Patent No. 1,684,266 and Baker's publication (Baker Oil Tools, Inc. - Special Products Manual regarding Baker Prime Fiberglass Packer Product 739-09 dated April 25, 1968 and the advertisement for Baker Fiberglass Packers found on page 135 of the June 1968 edition of World Oil), a copy of which is enclosed herewith, Applicant herein submits new claims 1 to 75. As discussed during Applicant's telephone interview of September 5, 2002 with Examiner Edward Dabrowski, new claims 1 to 73 and 75 are identical to claims1 to 73 and 75 of corresponding United States Patent No. 5,271,468 and are clearly patentable over the cited references and the rest of the art made of record, as acknowledged informally by the Examiner.

New claim 74 is also believed clearly patentable, as reciting a downhole packing apparatus comprising upper and lower slip means at least partly made of non-metallic material and being disposed respectively above and below packing means mounted on a mandrel.

Also attached for the Examiner's consideration is a Declaration made by Mr. M.E. (Monty) Harris on September 23, 2001. This declaration constitutes an annex to Mr. Harris's sworn statement of March 12, 2002, which was previously submitted. A copy of the front page of Mr. Harris's sworn statement is enclosed herewith.

Regarding the Examiner's objection under Section 140 of the *Patent Rules*, Applicant has amended pages 6 and 14 of the application to identify the trade-marks "Fiberite" and "Resinoid" as such. The claims have also been reviewed to identify every trade-mark as a trade-mark.

Under Rule 29, the Examiner is informed that Applicant is not aware of any additional relevant art, apart from what has already been submitted by Applicant.

FROM 20 SEP 2002

The Commissioner of Patents

Application No. 2,071,721

In view of the foregoing, it is believed that the application is in order for allowance, and an early and favourable action to that effect would be much appreciated.

Respectfully submitted,

HALLIBURTON COMPANMY

By:

Patent Agents of the Applicant

Encls. - new pp. 6 & 14 of disclosure
- new set of claims (pp. 34 to 44)
- copy of US Patent No. 1,684,266
- copy of Baker's publications (2)
- copy of Mr. M.E. Harris's Declaration

4650 20 OCT 2005

metal components.

In one embodiment of the downhole tool, the invention comprises a center mandrel and slips means disposed on the mandrel for grippingly engaging the well bore when in a set position. In packing embodiments, the apparatus further comprises a packing means disposed on the mandrel for sealingly engaging the well bore when in a set position.

The slip means may comprise a wedge engaging a plurality of slips with a slip support on the opposite side of the slips from the wedge. Any of the mandrel, slips, slip wedges or slip supports may be made of the non-metallic material, such as plastic. Specific plastics include nylon, phenolic materials and epoxy resins. The phenolic materials may further include any of Fiberite™ FM4056J, Fiberite™ FM4005 or Resinoid™ 1360. The plastic components may be molded or machined.

One preferred plastic material for at least some of these components is a glass reinforced phenolic resin having a tensile strength of about 18,000 psi and a compressive strength of about 40,000 psi, although the invention is not intended to be limited to this particular plastic or a plastic having these specific physical properties. The plastic materials are preferably selected such that the packing apparatus can withstand well pressures less than about 10,000 psi and temperatures less than about 425° F. In one preferred embodiment, but not by way of limitation, the plastic materials of the packing apparatus are selected such that the

FOSTER PEPPER & SHEFELMAN

also be made of an engineering grade plastic of substantially the same type as upper and lower slips wedges 32 and 46 and also lower slips housing 58.

Upper and lower slips 28 and 54 may also be of plastic in some applications. Hardened inserts for gripping well bore 12 when packer 20 is set may be required as part of the plastic slips. Such construction is discussed in more detail herein for other embodiments of the invention.

Lock ring housing 24, upper slip wedge 32, lower slip wedge 46, and lower slip housing 58 comprise approximately 75% of the cast iron of the prior art squeeze packers. Thus, replacing these components with similar components made of engineering grade plastics will enhance the drillability of packer 20 and reduce the time and cost required therefor.

Mandrel 22 is subjected to tensile loading during setting and operation, and many plastics will not be acceptable materials therefore. However, some engineering plastics exhibit good tensile loading characteristics, so that construction of mandrel 22 from such plastics is possible. Reinforcements may be provided in the plastic resin as necessary.

Example

A first embodiment packer 20 was constructed in which upper slip wedge 32 and lower slip wedge 46 were constructed by molding the parts to size from a phenolic resin plastic with glass reinforcement. The specific material used was Fiberite™ 4056J manufactured by Fiberite Corporation of Winona,

4056J - 2071721 2002-09-13

CLAIMS:

1. A well bore process comprising the steps of:
constructing a downhole tool such that a component thereof is made of a non-metallic material, said tool comprising:
a center mandrel; and
a plurality of slips disposed around said mandrel for grippingly engaging a well bore when in a set position;
wherein, at least one of said mandrel and said plurality of slips is said component;
positioning said downhole tool into locking, sealing engagement with said well bore; and
drilling said tool out of said well bore.

2. The process of claim 1 wherein said tool is selected from the group consisting of packers and bridge plugs.

3. The process of claim 1 wherein said component is subject to compressive loading.

4. The process of claim 1 wherein said component is subject to tensile loading.

5. The process of claim 1 wherein said center mandrel defines a central opening therein having a diameter less than about half an outside diameter of said center mandrel.

6. The process of claim 1 wherein said center mandrel defines a central opening therein having a diameter greater than about half the outside diameter of said center mandrel.

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7. The process of claim 1 wherein said non-metallic material is plastic.

8. The process of claim 7 wherein said component is molded.

9. The process of claim 7 wherein said plastic is selected from the group consisting of nylon, phenolic material or epoxy resin.

10. The process of claim 9 wherein said plastic is a phenolic material and is selected from the group consisting of Fiberite™ FM4056J, Fiberite™ FM4005 or Resinoid™ 1360.

11. The process of claim 1 wherein said step of drilling is carried out with a polycrystalline diamond compact bit.

12. The process of claim 1 wherein said step of drilling is carried out using a drill bit without substantially varying weight applied to said drill bit.

13. A well bore process comprising the steps of:
positioning and setting a packing device into locked, sealing engagement with a well bore, a portion of said device being made of engineering grade plastic;
contacting said device with well fluids; and
drilling out said device using a polycrystalline diamond compact bit.

14. The process of claim 13 wherein said step of contacting is at a temperature of less than about 250° F.

15. The process of claim 13 wherein said step of contacting is at a pressure of less than about 5,000 psi.

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16. The process of claim 13 wherein said portion of said device is at least one of a housing, slip, slip wedge, slip support, and mandrel thereof.

17. The process of claim 13 further comprising the step of, prior to said step of positioning and setting said device, drilling at least a portion of said well bore using a polycrystalline diamond compact bit.

18. The process of claim 13 wherein said step of drilling is carried out without substantially varying weight applied to said bit.

19. A downhole apparatus for use in a well bore, said apparatus comprising:
a center mandrel; and
slip means disposed on said mandrel for grippingly engaging said well bore when in a set position, said slip means comprising:
a slip wedge made of a non-metallic material; and
slips made of non-metallic material.

20. The apparatus of claim 19 characterized as a packing apparatus and further comprising packing means disposed on said mandrel for sealingly engaging said well bore when in a set position.

21. The apparatus of claim 20 wherein said slip means is an upper slip means disposed above said packing means and further comprising a lower slip means disposed below said packing means, said lower slip means comprising another slip wedge made of a non-metallic material.

FROM 2071721 2002-09-13

22. The apparatus of claim 19 wherein said slip means comprises a slip support made of a non-metallic material.

23. The apparatus of claim 19 further comprising a plurality of hardened inserts molded into said material of said slips.

24. The apparatus of claim 19 wherein said non-metallic material is an engineering grade plastic.

25. The apparatus of claim 24 wherein said plastic is nylon.

26. The apparatus of claim 24 wherein said plastic is a phenolic material.

27. The apparatus of claim 26 wherein said phenolic material is one of Fiberite™ FM4056J, Fiberite™ FM4005 and Resinoid™ 1360.

28. The apparatus of claim 24 wherein said plastic is an epoxy resin.

29. The apparatus of claim 24, wherein said wedge is molded to size.

30. A downhole apparatus for use in a well bore, said apparatus comprising:

a center mandrel made of a non-metallic material; and

slip means disposed on said mandrel for grippingly engaging said well bore when in a set position.

31. The apparatus of claim 30 characterized as a packing apparatus and further comprising packing means disposed on said mandrel for sealingly engaging said well bore when in a set position.

32. The apparatus of claim 30 wherein said slip means comprises a wedge made of a non-metallic material.

33. The apparatus of claim 30 wherein said slip means comprises slips made of a non-metallic material.

34. The apparatus of claim 30 wherein said non-metallic material is an engineering grade plastic.

35. The apparatus of claim 34 wherein said plastic is nylon.

36. The apparatus of claim 34 wherein said plastic is a phenolic material.

37. The apparatus of claim 36 wherein said phenolic material is Fiberite™ FM4056J.

38. The apparatus of claim 34 wherein said mandrel is molded to size.

39. The apparatus of claim 34 wherein said mandrel has a central opening defined therethrough having a diameter less than about half an outside diameter of said mandrel.

40. The apparatus of claim 34 wherein said mandrel has a central opening defined therethrough having a diameter greater than about half an outside diameter of said mandrel.

41. The apparatus of claim 34 wherein said plastic is an epoxy resin.

FORM 2045 2000-09-06

42. A downhole apparatus for use in a well bore, said apparatus comprising:
a center mandrel; and
a plurality of slips disposed around said mandrel for grippingly engaging said well bore when in a set position, said slips being made of a non-metallic material.

43. The apparatus of claim 42 characterized as a packing apparatus and further comprising packing means disposed on said mandrel for sealingly engaging said well bore when in a set position; and
wherein some of said slips are disposed above said packing means and some of said slips are disposed below said packing means.

44. The apparatus of claim 42 further comprising a wedge disposed adjacent to said slips, said wedge being made of a non-metallic material.

45. The apparatus of claim 42 wherein said mandrel is made of a non-metallic material.

46. The apparatus of claim 42 wherein said non-metallic material is an engineering grade plastic.

47. The apparatus of claim 46 wherein said plastic material is nylon.

48. The apparatus of claim 46 wherein said plastic is a phenolic material.

49. The apparatus of claim 48 wherein said phenolic material is Fiberite™ FM4056J.

50. The apparatus of claim 46 wherein said plastic is an epoxy resin.

FORM 2200-06 (2002/09)

51. The apparatus of claim 46 wherein said slips are molded of said plastic material.

52. The apparatus of claim 51 further comprising a plurality of hardened inserts molded into said plastic.

53. The apparatus of claim 52 wherein each of said inserts has an edge adapted for grippingly engaging said well bore.

54. A packing apparatus for use in a well bore, said apparatus comprising:
a mandrel made of a non-metallic material;
an upper slip support disposed on said mandrel and made of a non-metallic material;
a plurality of upper slips disposed around said mandrel and substantially made of a non-metallic material;
packing means disposed on said mandrel below said upper slips for sealingly engaging said well bore when in a set position;
a plurality of lower slips disposed around said mandrel below said packing means and substantially made of a non-metallic material; and
a lower slip support attached to said mandrel and made of a non-metallic material.

55. The apparatus of claim 54 wherein said non-metallic material of any of said mandrel, upper slip support, upper slips, lower slips and lower slip support is an engineering grade plastic.

56. The apparatus of claim 55 wherein said plastic is nylon.

2002-09-13 02071721

57. The apparatus of claim 56 wherein said phenolic material is one of Fiberite™ FM4056J, Fiberite™ FM4005 and Resinoid™ 1360.

58. The apparatus of claim 55 wherein said plastic is a phenolic material.

59. The apparatus of claim 55 wherein said plastic is an epoxy resin.

60. The apparatus of claim 55 wherein any of said mandrel, upper slip support upper slips, lower slips and lower slip support may be molded to size.

61. The apparatus of claim 59 wherein:
said center mandrel defines a mandrel central opening therethrough;
said lower slip support is characterized by a valve housing defining a housing central opening therein and a housing port in communication with said housing central opening; and
further comprising a valve disposed in said housing central opening and providing communication between said port and said mandrel central opening when in an open position, said valve being disposed below a lower end of said mandrel.

62. The apparatus of claim 61 wherein upward movement of said valve is prevented by said mandrel.

63. The apparatus of claim 61 wherein said valve is a sliding valve defining a valve central opening therein and a valve port in communication with said valve central opening, wherein said valve port and said housing port are substantially aligned when said valve is in an open position.

64. The apparatus of claim 63 wherein said valve defines a seal groove therein; and

further comprising sealing means disposed in said seal groove for providing sealing engagement between said valve and said valve housing.

65. The apparatus of claim 63 wherein said valve housing defines a seal groove therein; and
further comprising sealing means disposed in said seal groove for providing sealing engagement between said valve and said valve housing.

66. The apparatus of claim 63 further comprising a bumper seal disposed below said valve for cushioning said valve as said valve is moved to said open position thereof.

67. The apparatus of claim 63 further comprising means for preventing relative rotation between said sliding valve and said valve housing.

68. The apparatus of claim 61 wherein said valve is positioned below said housing port when said valve is in said open position.

69. The apparatus of claim 61 further comprising a poppet type valve disposed in said valve housing for providing communication between said mandrel central opening and said housing port when said valve is in an open position.

70. The apparatus of claim 54 further comprising a bridging plug disposed in said mandrel and sealingly engaged therewith.

71. The apparatus of claim 58 wherein:
said upper slip support has a tapered shoulder on a lower end thereof;
said upper slips have a tapered shoulder on an upper end thereof adapted for sliding engagement with said shoulder on said upper slip support;

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said lower slip support has a tapered shoulder on an upper end thereof; and
said lower slips have a tapered shoulder on a lower end thereof adapted for sliding engagement with said shoulder on said lower slip support.

72. The apparatus of claim 54 further comprising a plurality of inserts molded into each of said upper and lower slips, said inserts being made of a hardened material adapted for grippingly engaging said well bore.

73. A downhole apparatus for use in a well bore, said apparatus comprising:
a center mandrel made of a non-metallic material; and
slip means disposed on said mandrel for grippingly engaging said well bore when in a set position, said slip means comprising a slip wedge made of a non-metallic material.

74. A downhole apparatus for use in a well bore, said apparatus comprising:
a center mandrel;
a packing means disposed on said mandrel for sealingly engaging said well bore when in a set position;
an upper slip means disposed on said mandrel for grippingly engaging said well bore when in a set position, said upper slip means being at least partially made of non-metallic material, said upper slip means being disposed above said packing means; and
further comprising a lower slip means disposed on said mandrel for grippingly engaging said well bore when in a set position, said lower slip means being at least partially made of non-metallic material, said lower slip means being disposed below said packing means.

FORM 2 SEP 2000

75. A downhole apparatus for use in a well bore, said apparatus comprising:

a slip adapted for grippingly engaging the well bore, said slip being made of a non-metallic material; and

a hardened insert molded into said slip.

Sept. 11, 1928.

R. D. FISHER ET AL

1,684,266

BRIDGING PLUG

Filed Aug. 24, 1927

FIG. 1

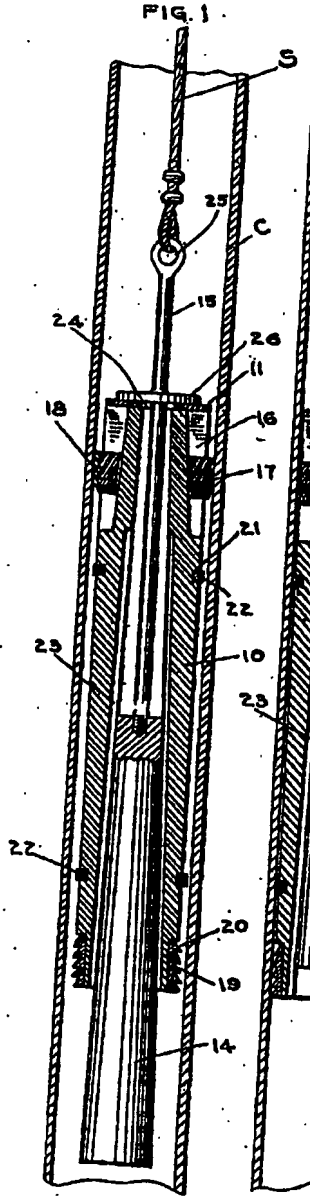


FIG. 2

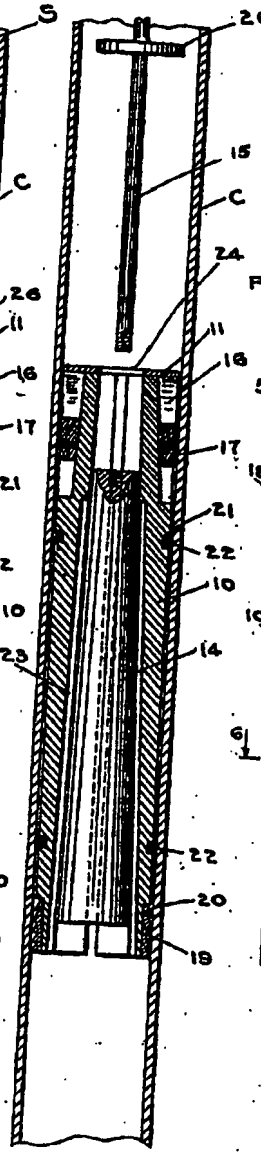


FIG. 4

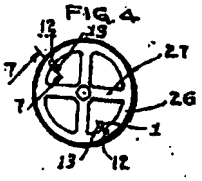


FIG. 3

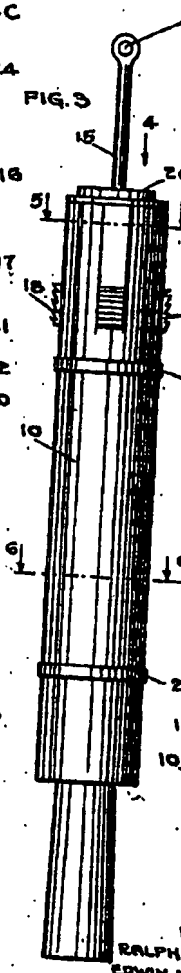


FIG. 5.

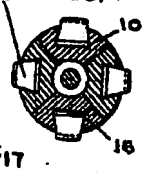


FIG. 6

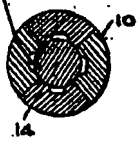
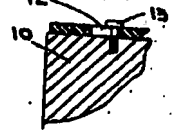


FIG. 7



INVENTORS
RALPH D. FISHER
EDWIN M. REARDON
BY Hazard and Miller
ATTORNEYS

Patented Sept. 11, 1928. 1,684,266

UNITED STATES PATENT OFFICE.

RALPH D. FISHER AND EDWIN M. REARDON, OF LONG BEACH, CALIFORNIA.

BRIDGING PLUG.

Application filed August 24, 1927. Serial No. 215,150.

This invention relates to improvements in bridging plugs for plugging up a casing in a well.

An object of the invention is to provide an improved bridging plug which can be seated so as to seal off the casing or to plug it up at any location within the well either intermediate the ends of the casing or at the very bottom.

Another object of the invention is to provide an improved bridging plug which, when seated within the casing, will be held against upward movement or downward movement for purposes hereinafter to be set forth.

Another object of the invention is to provide a bridging plug which is formed of a readily destructible material so that after the plug has been seated, it will be relatively easy to remove the same for further drilling operations by a drilling tool.

Another object of the invention is to provide a bridging plug which has passages therethrough, so that as the bridging plug is lowered into a well, fluid in the well may pass upwardly through the plug, and when the plug is seated, these passages will be closed to prevent any flow of fluid therethrough.

A further object of the invention is to provide an improved bridging plug carrying a sealing device which will engage the interior of the well casing and effectively form a packer or seal between the body of the plug and the casing to prevent leakage.

It will be understood that the improved bridging plug is designed to form a bridge or plug across the casing which may be used for many different purposes, such as cementing operations.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a vertical section through a well casing and through the improved bridging plug shown therein in the position wherein the plug is being lowered into the well.

Figure 2 is a view similar to Figure 1, showing the bridging plug after it has been seated.

Figure 3 is a view in side elevation of the improved bridging plug.

Figure 4 is a plan view taken in the direction of the arrow 4 upon Figure 3.

Figure 5 is a horizontal section taken upon the line 5—5 upon Figure 3.

Figure 6 is a horizontal section taken upon the line 6—6 upon Figure 3.

Figure 7 is a partial view in vertical section, taken upon the line 7—7 upon Figure 4 to illustrate a detail of construction.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the improved bridging plug consists of a plurality of segments 10 forming a cylinder. The number of segments illustrated upon the drawing is four, such number being taken to facilitate the illustration of the device, but it will be readily understood that the improved bridging plug can use any desired number of segments which will co-operate to form a complete cylinder of a diameter slightly smaller than the interior diameter of the casing C within which the plug is to be used. These segments 10 are held together at their upper ends by means of a circular disc of flexible material 11 which may be rubber or leather. Elongated slots 12 are formed in the disc 11, and screws 13 having relatively large heads, extend through the slots 12 forming a pin and slot connection between the upper ends of the segments 10 and the disc 11 so that the segments can separate to expand the cylinder. The interior surfaces of the segments 10 are so formed that they will co-operate to form a conical bore through the plug, complementary to a tapered mandrel 14. The segments 10 and the mandrel 14 are preferably formed of wood so that the plug can easily be drilled out of the casing by a drilling tool for further drilling operations. A draw bar 15 has its threaded lower end screwed into the upper end of the mandrel 14 so that by pulling upwardly on the draw bar 15 so as to raise the mandrel 14 within the segments 10, the segments will be moved into expanded position and caused to engage the interior surface of the casing C. On the exterior of each of the segments 10 and adjacent their respective upper ends, there is formed a groove 16 which is dovetailed in cross section as clearly shown upon Figure 5, and which has its back or bottom upwardly and

inwardly inclined slightly. Slidable slips 17 are slidable in these grooves and are retained in the grooves by the disc 11. These slips have upwardly directed teeth 18, which, when they engage the casing C, will prevent upward movement of the plug within the casing. Each of the segments 10 has a stationary slip 19 secured to its lower end, these slips being provided with downwardly directed teeth 20 which, when they engage the casing, will prevent downward movement of the plug. Horizontal grooves 21 are formed upon the exterior surfaces of the segments 10, and these receive rubber packing rings 22. On the interior surface of each of the segments 10 there is formed a groove 23. The grooves 23 extend upwardly from the bottom of each segment to a point some distance below the top of each segment. They are so arranged that when the mandrel 14 is in its bottom position as shown in Figure 1, the grooves terminate above the top of the mandrel, but when the mandrel is in its uppermost position as shown in Figure 2, the grooves 23 terminate below the top of the mandrel so that they are effectively closed by the mandrel when in this position. The draw bar 15 extends upwardly through an aperture 24 formed in the disc 11 and has an eye 25 formed on its upper end providing for the attachment of the sand line S. The draw bar has a ring 26 secured thereto by means of radial arms 27, thus forming a spider adapted to rest on top of the disc 11 when the plug is lowered into the well.

The operation of the improved bridging plug is as follows: If it is desired to plug off the casing at a predetermined level such as 2500 ft. from the surface, the plug is caused to assume the position shown in Figure 1 and attached to the sand line S. As it is lowered into the fluid filling the casing, the segments 10 being formed of wood, tend to float. They are caused to sink within the fluid by the ring 26 bearing evenly upon their upper ends. As the plug is being lowered, the slidable slips 17 tend to slide downwardly and outwardly within their respective grooves and engage the interior of the casing. When the desired level has been reached, an upward pull is imparted to the sand line S. The slidable slips 17 wedge between the backs of their respective grooves and the casing, and prevent the upward movement of the segments 10. The pull on the draw bar 15 raises the mandrel 14 causing it to expand the segments and to seal off the grooves 23. It will be understood that these grooves, when the plug was being lowered into the well, permit the circulation fluid to flow up through the plug and through the space between the arms 27. When the plug is expanded as a result of the separation of the segments by the mandrel 14, the stationary slips 20 are also caused to engage the casing and prevent downward movement of the plug. The rubber rings 22 also engage the casing and are compressed, thus forming a packer or seal to prevent the leakage of fluid between the exterior surface of the segments 10 and the casing. The improved bridging plug preferably employs both upwardly directed slips and slips having downwardly directed teeth. The teeth 18 prevent the plug from being forced upwardly in the event that the well should start to "heave." The downwardly directed teeth 20 prevent the plug from being forced downwardly by any pressure within the casing on top of the plug. As the mandrel 14 is formed of wood, the sand line S can be pulled upwardly with a sufficient force to draw the draw bar 15 out of the mandrel. It is drawn loose by merely stripping off the threads formed in the mandrel by screwing the lower end of the draw bar 15 into it. This leaves the bridging plug in the casing and sealing the casing at the proper level as shown in Figure 2. The slips 17 and 19 are preferably formed of cast iron or an equivalent frangible material which can be easily broken up by a drilling tool whenever it is desired to drill out the plug for further drilling operations.

The above described operation is in connection with plugging up the casing at some distance above its bottom. If it is desired to plug up the casing at the very bottom of the well, the draw bar 15 is left detached from the mandrel. The mandrel is held in its lowered position by merely driving a nail through one of the segments and into the mandrel. The plug is then placed in the casing and is forced downwardly by any heavy article such as a bailer attached to the sand line, S. The mandrel 14, having its lower end projecting below the segments 10, encounters the bottom of the well. By striking the top of the segments 10 with the bailer, the segments will be caused to slide downwardly upon the mandrel and to be expanded thereby into engagement with the casing, shearing off or bending the nail which temporarily held the mandrel in the position shown in Figure 1, relatively to the segments.

From the above described construction, it will be appreciated that a novel bridging plug is provided which can be easily, quickly and cheaply constructed, and which will effectively seal off or plug up a well casing. Furthermore, it is an easy matter to drill out the improved plug to carry on further drilling operations. The plug is held stationary in the casing against movement in either upward or downward directions, and carries a sealing means which will prevent leakage either between the segments 10 and the casing C, or between the sides of adjacent

segments which are separated slightly when the segments are expanded.

It will be understood that various changes in the details of construction may be made without departing from the spirit or scope of the invention as defined by the appended claims.

We claim:

1. A bridging plug comprising means forming a plurality of segments of a cylinder, a mandrel capable of being moved upwardly within the segments to separate them, means attached to the mandrel for lowering the device within a well casing, said means being detachable after the segments have been expanded, so as to be capable of being removed from the well casing, leaving the plug therein, and slips carried by said segments engageable upon the casing, some of the slips being designed to prevent upward movement of the plug within the casing, and others being designed to prevent downward movement of the plug within the casing.

2. A bridging plug comprising a plurality of segments of a cylinder, means for separating said segments into engagement with a well casing, and elastic means surrounding said segments adapted to be caused to engage the casing when the segments are separated to form a tight seal therewith, said segments having slips thereon, said slips being designed to engage the well casing so as to prevent upward and downward movement of the plug relatively thereto.

3. A bridging plug comprising a plurality of segments of a cylinder, means for expanding said plug into engagement with a well casing, and elastic means surrounding said segments adapted to be caused to engage the casing when the plug is expanded to form a tight seal therewith, said segments having grooves therein, slips slidable in the grooves and adapted to engage the interior of the well casing to prevent upward movement of the plug therein, and stationary slips carried by said segments engageable upon the interior of the well casing adapted to prevent downward movement of the plug therein.

4. A bridging plug comprising a plurality of segments of a cylinder, there being passages formed upon the segments permitting fluid to flow therethrough when the plug is lowered within a well casing, means for separating said segments to expand the plug into engagement with the well casing, said means serving to close said passages when the plug is expanded.

5. A bridging plug comprising a plurality of segments of a cylinder, a tapered mandrel adapted to be caused to slide upwardly within the segments to separate them, there being grooves formed upon the segments, slips slidable in the grooves and engageable upon the interior of a well casing to prevent upward and downward movement of the plug therein, and stationary slips carried by said segments engageable upon the well casing to prevent the downward movement of the plug therein, there being passages formed upon the segments adapted to allow fluid to flow therethrough when the plug is being lowered, said passages being so arranged as to be closed by the mandrel when the drill is moved into its uppermost position to expand the segments.

6. A bridging plug comprising a plurality of segments of a cylinder, a tapered mandrel adapted to be caused to slide upwardly within the segments to expand them, there being grooves formed upon the segments, slips slidable in the grooves and engageable upon the interior of a well casing to prevent upward movement of the plug therein, and elastic bands surrounding said segments adapted to be caused to engage the well casing to form a tight seal therewith.

7. A bridging plug comprising a plurality of segments of a cylinder, a tapered mandrel adapted to be caused to slide upwardly within the segments to separate them, there being grooves formed upon the segments, slips slidable in the grooves and engageable upon the interior of a well casing to prevent upward movement of the plug therein, and stationary slips carried by said segments engageable upon the well casing to prevent the downward movement of the plug therein, there being passages formed upon the segments adapted to allow fluid to flow therethrough when the plug is being lowered, said passages being so arranged as to be closed by the mandrel when the drill is moved into its uppermost position to separate the segments, a flexible member positioned over the top of said segments, headed pins extending through slots in said flexible member to join the segments together but to permit them to be separated, and a draw bar extending through the flexible member and threaded into the mandrel so as to be capable of being pulled out of the mandrel, said draw bar carrying an apertured flange engageable upon the top of the flexible member.

In testimony whereof we have signed our names to this specification.

E. M. REARDON.
R. D. FISHER.

EXHIBIT 1

TO J. Martin & Tech E

BAKER OIL TOOLS, INC.

INDEX 402-0049

T/M

199-998

SPECIAL PRODUCTS MANUAL

SUBJECT Baker Prime Fiberglass Packer
Product 739-09

DATE April 25, 1988

PURPOSE:

The primary application will be as an injection packer in wells using fiberglass tubing strings. The packer is constructed of epoxy-fiberglass laminates that maintain not only strength, but also, are free from chemical attack. The slips have carbide buttons bonded to the outer surface to enable them to bite into the casing, and the drag blocks have cobalt base inserts for wear resistance. Both materials are highly corrosion resistant. All packers have been manufactured and tested to temperatures, pressures, and tension in excess of the actual down-hole conditions to which they have been applied. The Size 43 and 45 Packers have been tested to 5000 psi with a 20,000 lb strain at 150° F. The Size 47 Packer has been tested to 400 psi with a 10,000 lb strain, and to a total tension pull of 20,000 lb at 150° F. However, these values may be extended as the applicable market for this packer increases. CONTACT PRODUCT ENGINEERING IF YOUR REQUIREMENTS EXCEED TEST RESULTS.

RUNNING:

The Fiberglass Packer is similar to a Model "A" Tension Packer, except for the Safety Release. Make up the tool to the tubing string using friction wrenches. If friction wrenches are not available, wrench on the box surface of the body and minimize wrench marking.

Run the tool to the desired setting depth, making sure the last motion is down. Rotate 1/4 turn to the left at the tool, and take a 3000 lb strain to pack off the 70-Hard Element of the Size 43 and 45 Packers; 5000 lb strain to pack off the 80-Hard Element of the Size 47 Packer.

RETRIEVING:

To release the tool, lower the tubing one foot and rotate 1/4 turn to the right to re-jay the Control Slip Unit. If it is necessary to use the emergency release, take a 1000 - 2000 lb strain and rotate to the right five turns at the tool. 150-20 ft/lb of torque is necessary to shear the Nylon Shear Screw(s) and rotate loose.

ASSEMBLY INSTRUCTIONS:

Slide the Control Slip Assembly onto the Body over the Cone Stop Ring. Insert the three J-Pins into the J-Pin Housing, align the drilled holes, insert the J-Pin Retainers, and Headless Brass Screws, and tighten. "Jay" the Control Slip Assembly onto the J-Slots of the Body. Make Safety Sub (applying Bakerseal to threads) onto Body, align Shear Screw hole(s), insert Nylon Shear Screw(s), and tighten.

DISASSEMBLY:

Use friction wrenches, if available; otherwise, wrench only on the large O.D.'s of the Safety Sub (left hand thread), Packing Element, and Cone. Un-jay the Control Slip Assembly and move it down far enough to expose and remove the Headless Brass Screws and J-Pin Retainers, holding the three J-Pins to the Housing. Shake the J-Pins out and remove the Control-Slip Assembly. Clean parts in solvent only. Do not steam Clean, as this will remove dry lubricant coatings.

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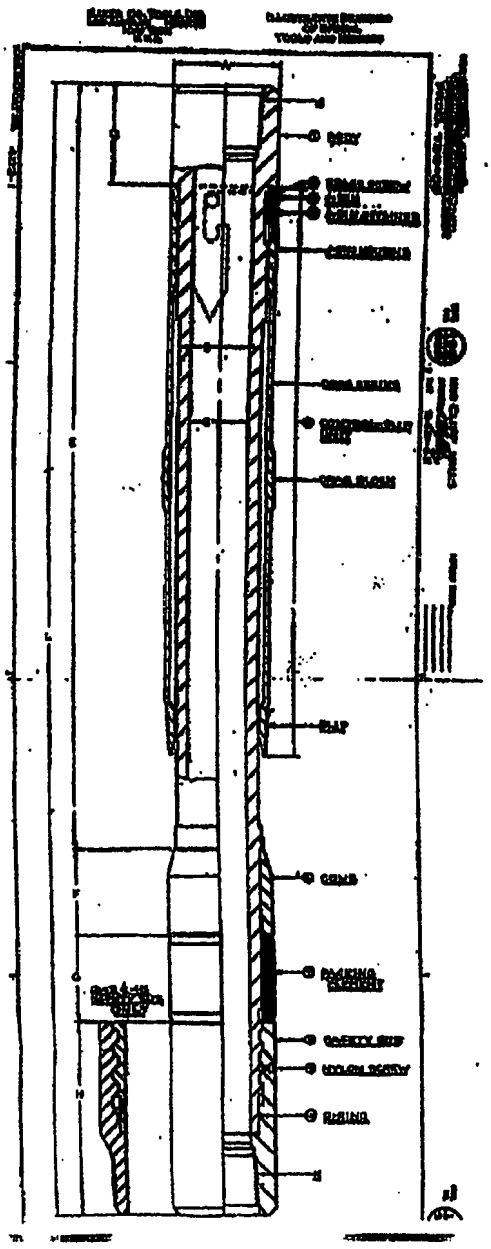

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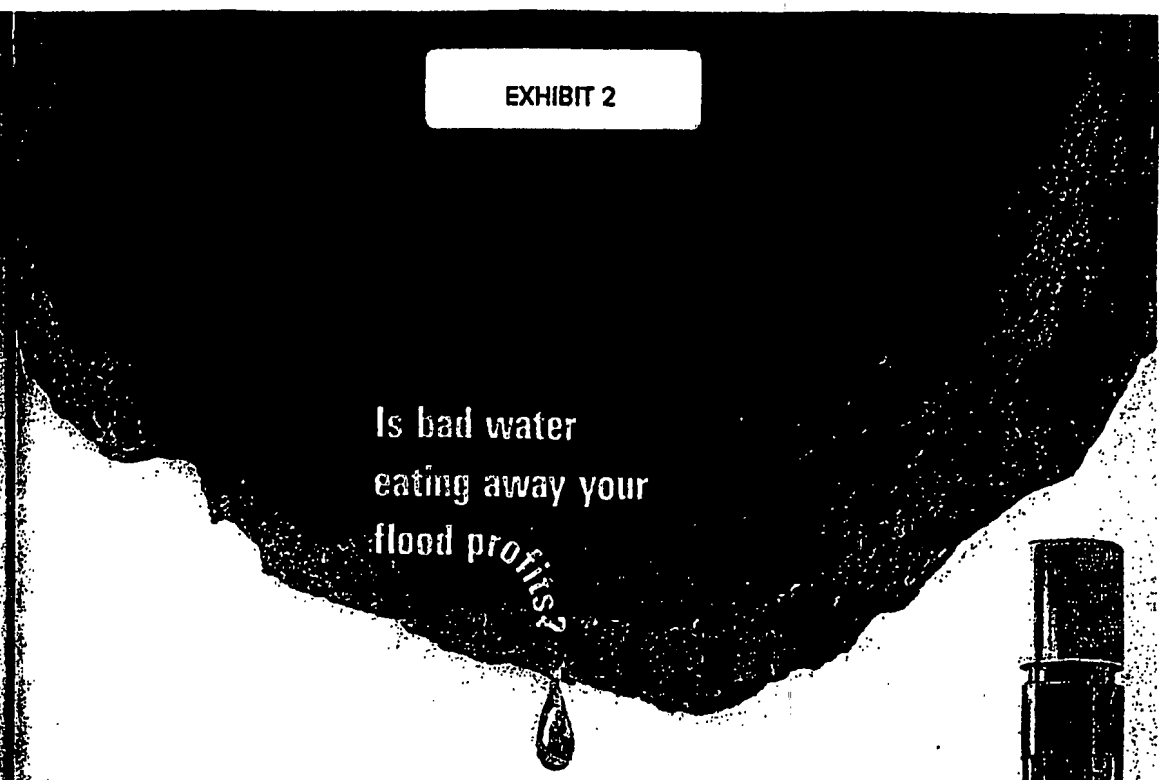
EXHIBIT 2



Baker introduces two packers as corrosion-proof as fiberglass tubing— because they are fiberglass!

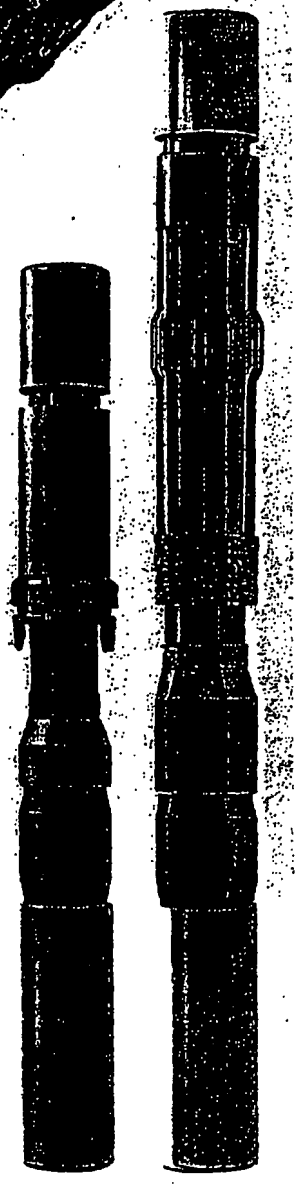
Corrosive fluid problems? Baker fiberglass packers were the answer for one operator. He asked Baker to build several all-fiberglass packers. These were custom packers made entirely of fiberglass—and they performed beautifully.

But many wells don't require the premium all-fiberglass construction. So a less expensive packer was developed that combines a fiberglass body and Kanigen-plated metal setting mechanism. For less money, it offers fiberglass protection wherever bad water contacts the packer. Saving just one round trip would more than pay for the difference in price between an ordinary packer and this economy fiberglass packer.

Do you have bad water problems that fiberglass packers can solve? Ask Baker to help you plan fiberglass in your next flood project. In 4½, 5½, and 7-inch sizes.

BAKER
FIBERGLASS PACKERS

BAKER OIL TOOLS INC. HOUSTON · LOS ANGELES · NEW YORK



World O.L 135

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SWORN STATEMENT

OF

MONTY EARLE HARRIS

MARCH 12, 2002

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SWORN STATEMENT OF MONTY EARLE HARRIS taken on the 12th day of March, 2002, before Kathy K. Elliott, Certified Court Reporter in and for the State of Texas, at the offices of Simon, Warner & Doby, L.L.P., 1700 City Center Tower II, 301 Commerce Street, Fort Worth, Texas.

LEGALINK Dallas

ORIGINAL

40904027/20006

DECLARATION OF M.E. (MONTY) HARRIS

1. My name is Monty Harris. I am President of Harris Tool and Specialty Co., Inc. in Azle, Texas.

2. In the mid-1960s, I was employed by Baker Oil Tools as a field engineer. One of my responsibilities as field engineer was to keep involved with new and useful products for the market. A retrievable tension packer was needed for use in wells where fiberglass tubing was being run for corrosion problems. Baker Oil Tools , engineering, made a tension packer that had a fiberglass mandrel along with other water wetted components made of the same. I personally ran two such packers for Marathon Oil Co on the Welder lease for salt-water disposal purposes.

3. This AD type Tension Packer for which I worked on the design was made of both metallic and non-metallic materials. The packer included a central mandrel. Disposed around the mandrel were metallic slips, then (going downwards), a metallic cone, an elastomeric packing element, a gauge ring and a collar. The mandrel, gauge ring and collar were made of fiberglass. I recall that several of these packers were also sold to Mobil Oil Company for use in wells in West Texas. Although these were considered "retrievable" packers, it was common to have to drill or mill these packers out of the well because of the parting of the fiberglass tubing and fishing practices.

4. In the 1980s, I was employed by The Western Company of North America. My position there was Field Engineering Manager for the company.

5. In the mid-1980s, while I was employed at The Western Company of North America, I worked on the design of a 9 5/8" drillable cement retainer (plug). The tool had a metallic mandrel and metallic slips. The rest of the tool was made mostly of non-metallic components. Richard A. Sukup and I were coinventors of United States Patent No. 4,708,202, which was directed in part to the 9 5/8" drillable plug described above.

6. Shortly thereafter, (and before 1985), I built two drillable plugs. The outside diameter of the plugs were designed to run inside 2 3/8" 4.7 #/Ft tubing. The inside diameter of the tubing was 1.995". The plug was made of glass-filled 610 nylon, with the exception of hardened steel inserts in the slips and packing shoes that were made of brass. Attachment A to my declaration depicts the 2 3/8" plug.

7. The 2 3/8" plug had a non-metallic mandrel, non-metallic slips (other than the hardened tungsten steel inserts), non-metallic cones, a non-metallic guide, a non-metallic top lock ring and elastomeric seal elements. I manufactured the plugs such that they had to be set using a wireline and a Baker setting tool.

8. I personally tested one of the plugs and determined that it performed satisfactorily.

40902403.020605

9. I sent the other plug to a "Cap" duPont, the Louisiana district manager for The Western Company, Crowley Louisiana for use in the field. Cap duPont gave the plug to a salesman for The Western Company of North America, with instructions to find a customer who would run such plug in his well thus constituting a field run. The salesman found a customer who was willing to have the plug set in his well in Louisiana as part of the customer's well activities.

10. The plug was set in the well by a wireline company with a Baker setting tool. Although the plug was successfully set in the well and performed as required, the setting process utilized too much force and a portion of the mandrel snapped off.

11. The wireline operator, the customer and others who were at the wellsite were not required to execute non-disclosure agreements or were not otherwise required to maintain any sort of secrecy about the plug, how it was used or what it was made of\

12. The above information is to the best of my knowledge from past years.

I declare under penalty of perjury under the laws of the Unites States of America that the foregoing is true and correct.

Executed on 09/23, 2001.

M.E. "Monty" Harris

4090720 07/27/2006

ATTACHMENT B

In the mid-1980s, Monty Harris, then of the Western Company developed a 2-3/8" plug made almost entirely of composite materials.

The plug was comprised of a composite mandrel with a composite guide at the lowest part of the mandrel. An elastomeric seal was disposed around the mandrel just above the guide. Next, two packer element retaining shoes were disposed around the mandrel. The first shoe was made of brass, the second was made of a composite. The shoes were made of a multitude of segments that were kept in position by a ring integrally formed with the shoe segments. The shoe segments of the brass and composite packer shoes were offset. When the tool was set, both the brass and composite shoe segments extended to the wellbore in order to prevent extrusion of the element. Both the brass and composite shoe segments engaged the elastomeric seal.

Above the shoe assembly was a cone and then a set of slips. The cone and slips were fabricated from a composite material. The slips had tungsten inserts on their outer surface. The slips were kept in their initial position by virtue of drive pins that went through the slips and into the cones and by virtue of a spring that was used as a band that encircled the slips, residing in a groove in the center of the slips. Each slip had two sets of teeth, upper and lower. Above the slips and disposed around the mandrel, the tool had a mirror-image assembly consisting of a cone, shoes and a seal. Above the seal, a composite top lock ring with body lock was disposed around the mandrel.

The upper and lower sets of teeth did not engage the well bore simultaneously. Instead, they were arranged such that first, the upper end of the slips would ride up the upper cone and engage the wellbore. The bottom sub would act as a support for the

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upper end of the slips during this part of the operation. Then, the lower end of the slips would ride up the lower cone and engage the wellbore. The composite top ring with body lock ring would act as a support for the lower end of the slips during this part of the setting operation.

The composite components of the 2-3/8" plug were made of glass-filled 610 nylon. Harris Decl.

One of these 2-3/8" plugs was sent to a customer in Louisiana where the plug was set in a well at a drill site with a wire line tool by a wire line operator. The Western Company did not attempt to maintain any secrecy concerning the 2-3/8" plug when it was used in this well. . The 2-3/8" plug performed satisfactorily, although a piece of the mandrel broke off because the tool was set too aggressively. The tool was set before 1985.

SEP 05 2002 09:30

May 21, 2002

SWABEY OGILVY RENAULT
1600 - 1981 McGill College Avenue
MONTREAL Quebec
H3A 2Y3

Application No.	:	**2,071,721**
Owner	:	HALLIBURTON COMPANY
Title	:	**DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF**
Classification	:	E21B-34/12
Your File No.	:	**5059-598**
Examiner	:	Edward Dabrowski, P.Eng.

OPIC - CIPO 19 2002-11-20

IN ACCORDANCE WITH SUBSECTION 30(2) OF THE PATENT RULES, YOU ARE HEREBY NOTIFIED OF A REQUISITION BY THE EXAMINER. IN ORDER TO AVOID ABANDONMENT UNDER PARAGRAPH 73(1)(A) OF THE PATENT ACT, A WRITTEN REPLY MUST BE RECEIVED WITHIN 4 MONTHS AFTER THE ABOVE DATE.

This application has been examined as per amendment of June 23, 1998.

The number of claims in this application is 76.

The examiner has identified the following defects in the application:

A search of the prior art has revealed the following:

References Applied:

United States Patents

2043225	June 9, 1936	166-1	Armentrout et al.
4300631	November 17, 1981	E21B-33/00	Sainato et al.
4708202	November 24, 1987	E21B-23/00	Sukup et al.
4858687	August 22, 1989	E21B-33/16	Watson et al.

Armentrout et al. describes an apparatus for bore-hole use that is constructed using materials that can be readily drilled up, that being inexpensive friable materials. This basic idea necessarily points to the use of any material suited to easy drilling. Sainato shows that a part, in this case the mandrel, can indeed be made of plastic. It would not take uncommon knowledge to associate the use of plastics for other parts; constituting elements whose strength properties admit easier drilling. Sukup talks of facilitating the drilling out of tools or components thereof through the use of resins. Watson includes plastics for a bore-hole plug set and the use of PDC drill bits for drilling out those parts. It should be noted that the gist of

invention in each of these aforementioned did not simply lie with the obvious substitution of materials suitable to a given application. The present invention admits, as on page 5, to the application of materials because of their ease to be drilled out to any bore-hole tool - something which is expected. Geometric changes to elements within the present invention stemming from lesser strength would also be foreseen by those skilled in the art. The substitution of specific similar materials merely based on a physical property lending itself to being drilled out is obvious, i.e. nylon, epoxy resin. The present invention's claims to selected temperatures less than 250°F, uniform drilling weights, and contact pressures less than 5000 psi are intrinsic to whatever the drilling conditions would demand, e.g. a drill force would necessarily be suitably applied to the material being drilled. The manner of element construction or geometry, i.e. moulded, shape, or insertions doesn't constitute inventiveness in the present invention. Accordingly,
this application does not comply with Section 28.3 of the Patent Act. All of the subject matter described and claimed in this application would have been obvious on the claim date to a person skilled in the art or science to which it pertains having regard to the aforementioned patents.

Under Section 140 of the Patent Rules, every trade-mark must be identified as a trade-mark. If "Fiberite" and "Resinoid" are trade-marks, they must be so identified in the description at least at the first occasion of use, and at every occasion in the claims. See Claims 12, 31, 41, 53, and 62.

Under Section 29 of the Patent Rules, applicant is requisitioned to provide particulars of conflict, opposition, re-examination or similar proceedings in which the corresponding United States and European Patent Office applications may have been involved.

In view of the foregoing defects, the applicant is requisitioned to amend the application in order to comply with the Patent Act and the Patent Rules or to provide arguments as to why the application does comply.

Edward Dabrowski, P.Eng.
Patent Examiner
(819) 953-1378

File No.: 5059-598 RM/SC/ip

Montreal, Canada
June 22, 1998

IN THE CANADIAN PATENT OFFICE

JUN 23 1998
June 23/98

In re Application of : Halliburton Company

For : Downhole Tool Apparatus With Non-Metallic Components And Methods Of Drilling Thereof

Serial No. : 2,071,721

Filed : June 19, 1992

Classification : E21B-34/12

Examiner : W. J. Dutkiewicz

Agent : Robert Mitchell Tel.: (514) 845-7126

AMENDMENT

The Commissioner of Patents
Hull-Ottawa, Canada
K1A 0C9

Madam:

This is in response to the Official Action dated April 3, 1998.

Kindly amend the application in the following respects:

DISCLOSURE:

Kindly substitute the enclosed new pages 1 and 28 for corresponding pages 1 and 28 at present on file.

- R E M A R K S -

Claims 1 to 76 remain in the application.

As requested by the Examiner, former pages 1 and 28 of the Disclosure have been amended to remove reference to United States Patent Application Serial No. 07/515,019 and the sentence regarding the incorporation by reference, respectively.

In view of the foregoing, it is believed that the application is in order for allowance, and an early and favorable action to that effect would be much appreciated.

Respectfully,

HALLIBURTON COMPANY

By: Swabey Ogilvy Renault

Patent Agents of the Applicant

Encl. - new pages 1 & 28 of Disclosure

h0904: 20 JUL 2006

Les pages suivantes ont été annulées par un amendement.

The following pages have been cancelled by an amendment.

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DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF

This application is a continuation-in-part of co-pending Application Serial No. 07/515,019, filed April 26, 1990.

Background Of The Invention

1. Field Of The Invention

This invention relates to downhole tools for use in well bores and methods of drilling such apparatus out of well bores, and more particularly, to such tools having drillable components therein made of non-metallic materials, such as engineering grade plastics.

2. Description Of The Prior Art

In the drilling or reworking of oil wells, a great variety of downhole tools are used. For example, but not by way of limitation, it is often desirable to seal tubing or other pipe in the casing of the well, such as when it is desired to pump cement or other slurry down tubing and force the slurry out into a formation. It then becomes necessary to seal the tubing with respect to the well casing and to prevent the fluid pressure of the slurry from lifting the tubing out of the well. Packers and bridge plugs designed for these general purposes are well known in the art.

When it is desired to remove many of these downhole tools from a well bore, it is frequently simpler and less expensive to mill or drill them out rather than to implement a complex retrieving operation. In milling, a milling cutter is used to grind the packer or plug, for example, or at least the outer components thereof, out of the well bore. Milling is a

the numeral 600. Second bridge plug embodiment 600 uses the same thin cross-sectional mandrel 202 as does third packer embodiment 200 shown in FIG. 4A. Also, the external components positioned on center mandrel 202 are the same as previously described, so the same reference numerals are used in FIG. 8.

In second bridge plug embodiment 600, the lower end of center mandrel 202 is attached to the same lower slip support 502 as first bridge plug embodiment 500 at threaded connection 602. It will be seen that bore 508 in lower slip support 502 is in communication with mandrel central opening 204 in center mandrel 202.

A bridging plug 604 is positioned in the upper end of mandrel central opening 204 in center mandrel 202. A shoulder 608 in central opening 204 prevents downward movement of bridging plug 604. A sealing means, such as a plurality of O-rings 606, provide sealing engagement between bridging plug 604 and center mandrel 202.

Tension sleeve 238, previously described, is positioned above bridging plug 604.

4,690,210 - 2 SEP 2005

Setting And Operation Of The Apparatus

Downhole tool apparatus 10 is positioned in well bore 12 and set into engagement therewith in a manner similar to prior art devices made with metallic components. For example, a prior art apparatus and setting thereof is disclosed in the above-referenced U. S. Patent No. 4,151,875 to Sullaway. This patent is incorporated herein by reference.

Bureau des brevets Patent Office

APR - 3 1998

Swabey Ogilvy Renault
1600 - 1981 McGill College Avenue
MONTREAL Quebec
H3A 2Y3

apr 3/98

Application No.	:	**2,071,721**
Owner	:	Halliburton Company;
Title	:	DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF
Classification	:	E21B-34/12
Your File No.	:	**5059-598**

IN ACCORDANCE WITH SUBSECTION 30(2) OF THE PATENT RULES, YOU ARE HEREBY NOTIFIED OF A REQUISITION BY THE EXAMINER. IN ORDER TO AVOID ABANDONMENT UNDER PARAGRAPH 73(1)(A) OF THE PATENT ACT, A WRITTEN REPLY MUST BE RECEIVED WITHIN 6 MONTHS AFTER THE ABOVE DATE.

This application has been examined taking into account applicant's correspondence dated January 24, 1997.

The number of claims in this application is 76.

A search of the prior art has thus far failed to reveal any pertinent references.

The examiner has identified the following defects in the application:

In accordance with Subsection 137(2) of the Patent Rules all documents referred to in the description of an application must have been available to the public when the application was filed. Reference to the document on page 1 does not comply with this Subsection and must be deleted.

A statement in an application, such as found on page 28, which incorporates by reference any other document does not comply with Subsection 137(1) of the Patent Rules.

In view of the foregoing defects, the applicant is requisitioned to amend the application in order to comply with the Patent Act and the Patent Rules or to provide arguments as to why the application does comply.

W.J. Dutkiewicz
Examiner
(819) 997-2772

/mc

D.F.

File No. 5059-598 RM/EC

Montreal, Canada
January 24, 1997

In re Application of
HALLIBURTON COMPANY
Serial No. 2,071,721
Filed June 19, 1992
For: DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF

Industrie Canada Industry Canada
OPIC CIPO
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Dossier Filed JAN 24/97
Remis a Charged to

The Commissioner of Patents,
Ottawa-Hull, Canada.
K1A 0C9

JAN 29 1997
W5435 235
13464
J1000 29201 400

Sir:

The applicant,
HALLIBURTON COMPANY,
P. O. Box 1431,
Duncan, Oklahoma 73536,
U. S. A.,

requests examination of the above-noted application. To this end, a cheque in the amount of $400.00 is enclosed to cover the Government examination fee.

The history of the corresponding United States application and the references cited at each stage are as follows:

(1) United States application No. 515,019 was abandoned. During the prosecution of this United States application, the following references were cited:

U. S. Patent	4,708,202	1987	Sukup et al
" "	4,858,687	1989	Watson et al
" "	4,834,184	1989	Streich et al
" "	3,910,348	1975	Pitts

The Commissioner of Patents

(2) U. S. Patent 5,271,468 issued on December 21, 1993 from a continuation-in-part application. A copy of the front page of this patent is enclosed. The Examiner will note the references which were cited during the prosecution thereof.

(3) U. S. Patent 5,224,540 issued on July 6, 1993 from a continuation-in-part application. A copy of the front page of this patent is enclosed from which the Examiner will note the list of references cited.

(4) U. S. Patent 5,390,737 issued on February 21, 1995 from a continuation-in-part application. A copy of the front page of this patent is enclosed from which the Examiner will note the list of references cited.

Copies of the non-patent publications cited against these patents are also enclosed.

In the European Patent Office, the following history is noted:

(1) EP 91303763.6 was abandoned. During the prosecution of this European application, the following references were cited in the European Search Report:

US-A-4 708 202	Sukup
US-A-4 858 687	Watson
US-A-4 836 279	Freeman
US-A-4 151 875	Sullaway
EP-A-0 306 306	Halliburton
US-A-4 175 619	Davis

(2) EP Patent 0 519 757 was granted on November 8, 1995 based on United States continuation-in-part application No. 719,740. A copy of the front page of this European patent is enclosed from which the Examiner will note the references cited.

The Commissioner of Patents

(3) EP application No. 93303523.0 based on United States continuation-in-part application No. 883,619 was filed and is still pending. The references which were cited in the European Search Report are as follows:

EP-A-0 454 466 Halliburton Co.
US-A-3 529 667 B. C. Malone
EP-A-0 519 757 Halliburton Co.

Early and favourable action would be much appreciated.

Respectfully,
HALLIBURTON COMPANY
By:

Patent Agents of the Applicant

Encs. - cheque $400.00
cc. of front pgs. of
U.S. Patents 5,271,468,
5,224,540 & 5,390,737
cc. of front pg. of
EP Patent 0 519 757
non-patent publns.

Agent of Record - Robert Mitchell
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Swabey Ogilvy Renault
Suite 1600
1981 McGill College Avenue
Montreal, Quebec
H3A 2Y3

Date: 1997/02/18

ACKNOWLEDGEMENT OF REQUEST FOR EXAMINATION

N° de demande/Application No.	:	2,071,721
Propriétaire/Owner	:	Streich, Steven G.; et al.
Titre/Title	:	DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF
Classification/Classification	:	E21B-034/12
Votre référence/Your Reference	:	5059-598

Nous accusons réception de la requête d'examen et de la taxe prescrite.

L'examen de la demande suivra son cours.

The Request for Examination and prescribed fee have been received.

Examination of the application will take place in due course.

2071721 - 1997/02/18

US005271468A

United States Patent [19]

Streich et al.

[11] Patent Number: 5,271,468

[45] Date of Patent: Dec. 21, 1993

[54] DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF

[75] Inventors: Steven G. Streich; Donald F. Hushbeck; Kevin T. Berscheidt; Rick D. Jacobi, all of Duncan, Okla.

[73] Assignee: Halliburton Company, Duncan, Okla.

[21] Appl. No.: 719,740

[22] Filed: Jun. 21, 1991

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 515,019, Apr. 26, 1990, abandoned.

[51] Int. Cl.[5] E21B 33/129

[52] U.S. Cl. 166/387; 166/118; 166/134; 166/217; 166/376; 175/57

[58] Field of Search 166/376, 387, 118, 135, 166/134, 138, 179, 192, 382, 123, 128, 242; 175/57

[56] References Cited

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2,043,225	6/1936	Armentrout et al. .	
2,155,129	4/1939	Hall et al. .	
2,205,119	6/1940	Hall et al. .	
2,589,506	3/1952	Morrisett .	
3,055,424	9/1962	Allen	166/242 X
3,529,667	9/1970	Malone .	
3,910,348	10/1975	Pitts	166/134
4,067,358	1/1978	Streich	137/624.13
4,151,875	5/1979	Sullaway	166/126
4,300,631	11/1981	Sainato et al.	166/187
4,708,202	11/1987	Sukup et al.	166/123
4,784,226	11/1988	Wyatt	166/376
4,834,184	5/1989	Streich et al.	166/376
4,858,687	8/1989	Watson et al.	166/153
4,977,958	12/1990	Miller	166/205

OTHER PUBLICATIONS

Halliburton Sales & Service Catalog No. 43, published in 1985, pp. 2561-2562; 2556-2557; 2427-2434.

Halliburton Services Sales Technical Paper S-8107 entitled "Successful Drill Out Of Shoe Joints With PDC Bits", published in Mar., 1989.

Chapter 4, Fundamentals of Drilling, by John L. Kennedy, PennWell Books, Copyright 1983.

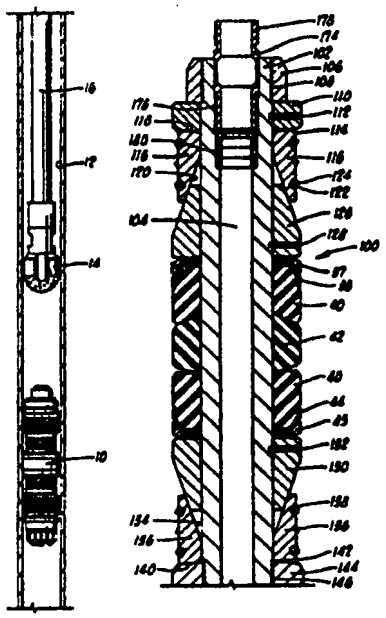
"Molding Compounds Materials Selection Handbook", published by Fiberite Corporation, Copyright, 1986.

Primary Examiner—Stephen J. Novosad

[57] ABSTRACT

A downhole tool apparatus and methods of drilling the apparatus. The apparatus may include, but is not limited to, packers and bridge plugs utilizing non-metallic components. The material may include engineering grade plastics. The nonmetallic components may include but are not limited to the center mandrel, slips, slip wedges, slip supports and housings, spacer rings, valve housings and valve components. Methods of drilling out the apparatus without significant variations in the drilling speed and weight applied to the drill bit may be employed. Alternative drill bit types, such as polycrystalline diamond compact (PDC) bits may also be used.

75 Claims, 6 Drawing Sheets



US005224540A

United States Patent [19]

Streich et al.

[11] Patent Number: 5,224,540

[45] Date of Patent: Jul. 6, 1993

[54] **DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF**

[75] Inventors: Steven G. Streich; Donald F. Hushbeck; Kevin T. Berscheidt; Rick D. Jacobi, all of Duncan, Okla.

[73] Assignee: Halliburton Company, Duncan, Okla.

[21] Appl. No.: 883,619

[22] Filed: May 12, 1992

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 719,740, Jun. 21, 1991, which is a continuation-in-part of Ser. No. 515,019, Apr. 26, 1990, abandoned

[51] Int. Cl.[5] E21B 33/129

[52] U.S. Cl. 166/118; 166/123; 166/128; 166/134; 166/382

[58] Field of Search 166/387, 376, 115, 135, 166/138, 179, 192

[56] **References Cited**

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2,155,129	4/1939	Hall et al	166/376
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3,055,424	9/1962	Allen	166/242 X
3,529,667	9/1970	Malone	166/387
3,910,348	10/1975	Pitts	166/134
4,067,358	1/1978	Streich	137/624.13
4,151,875	5/1979	Sullaway	166/120
4,300,631	11/1981	Sainato et al.	166/187
4,708,202	11/1987	Sukup et al.	166/123
4,784,226	11/1988	Wyatt	166/376
4,834,184	5/1989	Streich et al.	166/376
4,848,467	7/1989	Watson et al	166/153
4,977,958	12/1990	Miller	166/205

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Halliburton Sales & Service Catalog No. 43, published in 1985, pp. 2561-2562; 2556-2557; 2427-2434.

Halliburton Services Sales Technical Paper S-8107 entitled "Successful Drill Out Of Shoe Joints With PDC Bits", published in Mar., 1989.

Chapter 4, *Fundamentals of Drilling*, by John L. Kennedy, PennWell Books, Copyright 1983.

"Molding Compounds Materials Selection Handbook", published by Fiberite Corporation, Copyright, 1986.

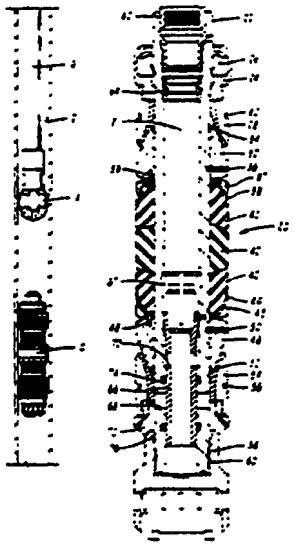
Primary Examiner—Stephen J. Novosad

Attorney, Agent, or Firm—James R. Duzan; Neal R. Kennedy

[57] **ABSTRACT**

A downhole tool apparatus and methods of drilling the apparatus. The apparatus may include, but is not limited to, packers and bridge plugs utilizing non-metallic slip components. The non-metallic material may include engineering grade plastics. In one embodiment, the slips are separate and held in place in an initial position around the slip wedge by a retainer ring. In another embodiment, the slips are integrally formed with a ring portion which holds the slips in the initial position around the wedge; in this embodiment, the ring portion is made of a fracturable non-metallic material which fractures during a setting operation to separate the slips. Methods of drilling out the apparatus without significant variations in the drilling speed and weight applied to the drill bit may be employed. Alternative drill bit types, such as polycrystalline diamond compact (PDC) bits may also be used.

41 Claims, 7 Drawing Sheets



US005390737A

United States Patent [19]

Jacobi et al.

[11] Patent Number: 5,390,737

[45] Date of Patent: Feb. 21, 1995

[54] **DOWNHOLE TOOL WITH SLIDING VALVE**

[75] Inventors: Ricky D. Jacobi; Kevin T. Berscheidt; Donald F. Hushbeck, all of Duncan, Okla.

[73] Assignee: Halliburton Company, Duncan, Okla.

[21] Appl. No.: 99,690

[22] Filed: Jul. 29, 1993

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 719,740, Jun. 21, 1991, Pat. No. 5,271,468, which is a continuation-in-part of Ser. No. 515,019, Apr. 26, 1990, abandoned.

[51] Int. Cl.[6] E21B 23/00; E21B 33/128; E21B 33/129; E21B 34/14

[52] U.S. Cl. 166/184; 166/131; 166/185; 166/242; 166/134; 166/142; 166/387

[58] Field of Search 166/131, 184, 123, 185, 166/186

[56] **References Cited**

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4,834,176	5/1989	Renfroe, Jr.	166/142
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4,858,687	8/1989	Watson et al.	166/153
4,915,175	4/1990	Mashaw, Jr.	166/332
4,977,958	12/1990	Miller	166/205

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Halliburton Sales & Service Catalog No. 43, published in 1985, pp. 2561-2562; 2556-2557; 2427-2434.

Halliburton Services Sales Technical Paper S-8107 entitled "Successful Drill Out of Shoe Joints with PDC Bits," published in Mar., 1989.

Chapter 4, *Fundamentals of Drilling*, by John L. Kennedy, PennWell Books, Copyright 1983.

"Molding Compounds Materials Selection Handbook," published by Fiberite Corporation, Copyright, 1986.

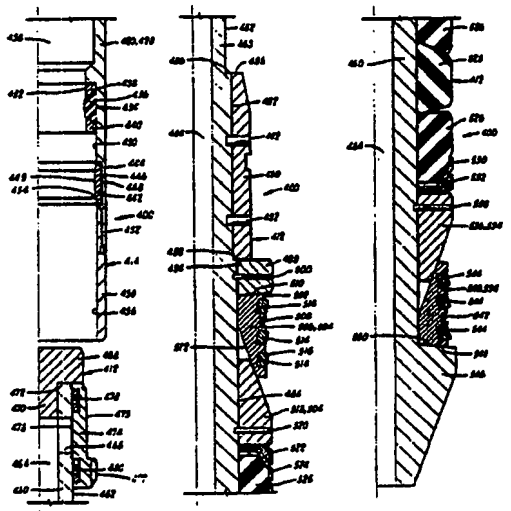
Primary Examiner—Stephen J. Novosad

Attorney, Agent, or Firm—Stephen R. Christian; Neal R. Kennedy

[57] **ABSTRACT**

A downhole tool apparatus and methods of drilling the apparatus. The apparatus may include, but is not limited to, packers and bridge plugs utilizing non-metallic components. The non-metallic components may include but are not limited to the center mandrel having an unmachined, molded central opening therethrough. In a preferred embodiment, a sliding valve is disposed on an outer surface of the center mandrel for opening and closing a valve port. An overshot is used to selectively actuate the sliding valve. Methods of installation and drilling out of the apparatus are also disclosed.

20 Claims, 6 Drawing Sheets



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 519 757 B1**

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **08.11.95** (51) Int. Cl.[6] **E21B 33/129**

(21) Application number: **92305707.9**

(22) Date of filing: **22.06.92**

(54) Downhole tool apparatus.

(30) Priority: **21.06.91 US 719740**

(43) Date of publication of application:
23.12.92 Bulletin 92/52

(45) Publication of the grant of the patent:
08.11.95 Bulletin 95/45

(84) Designated Contracting States:
AT DE FR GB IT NL

(56) References cited:
EP-A- 0 454 466
US-A- 4 151 875

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Inventor: **Berscheidt, Kevin T.**
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Inventor: **Jacobi, Rick D.**
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(74) Representative: **Wain, Christopher Paul et al**
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Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

EP 0 519 757 B1

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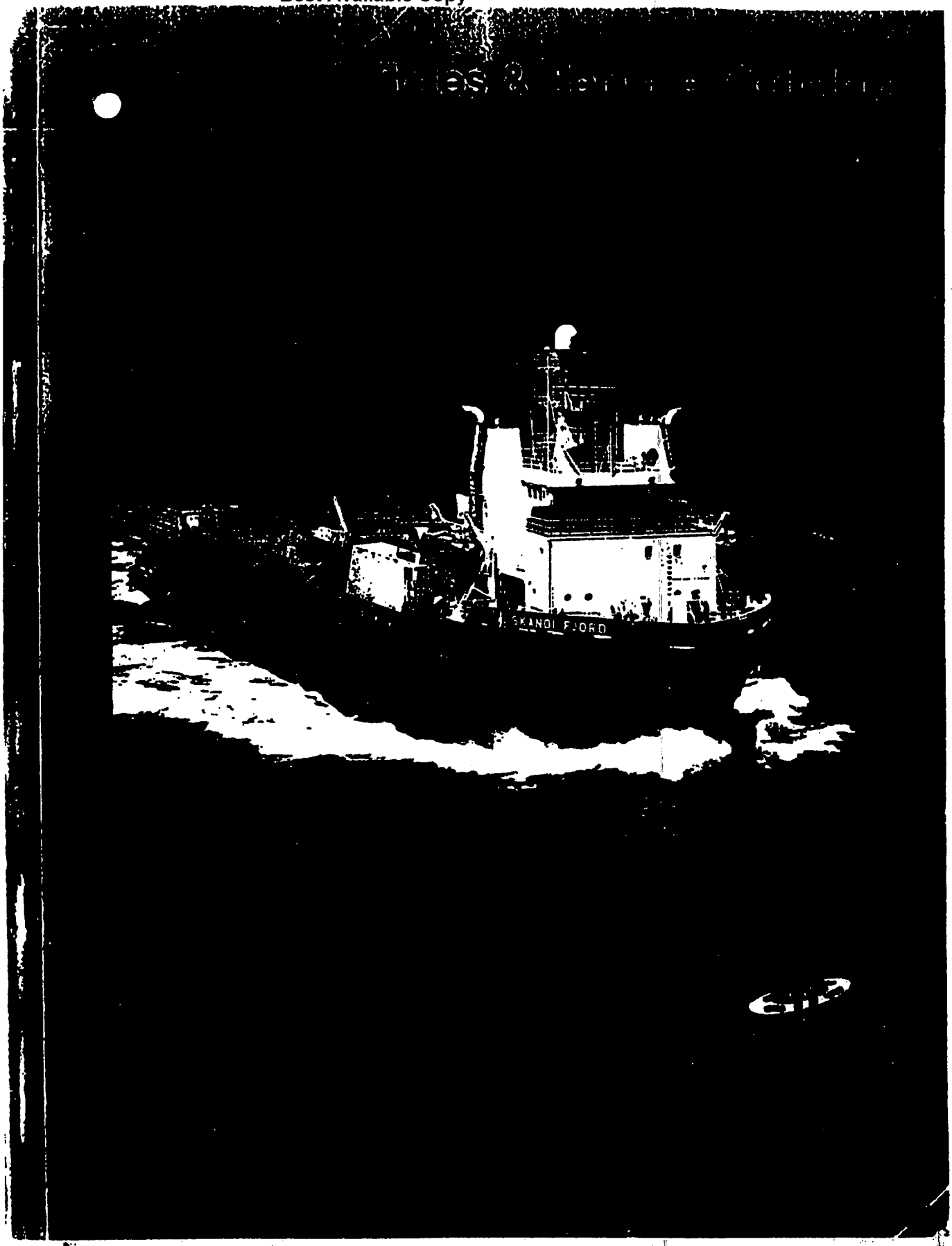

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Packers

EZ Drill®
Squeeze Packers

Halliburton Services field proven EZ Drill® Squeeze Packers permit faster removal from the well by either rotary or cable tool methods without reduction in operating performance at even elevated temperatures and pressures.

In addition, OD of the tool is less and ID of the tool is greater than comparable products now in use, permitting faster running-in and quicker displacement of fluids at less pressure. Drilling out time is significantly quicker than comparable products.

The EZ Drill squeeze packer contains a spring-loaded back-pressure valve. The main structural parts of this tool are made of controlled cast iron.

The EZ Drill SV squeeze packer contains a pressure-balanced sliding valve for control of fluid movement in the well. As with the other type, the main structural parts of this tool are made of controlled cast iron.

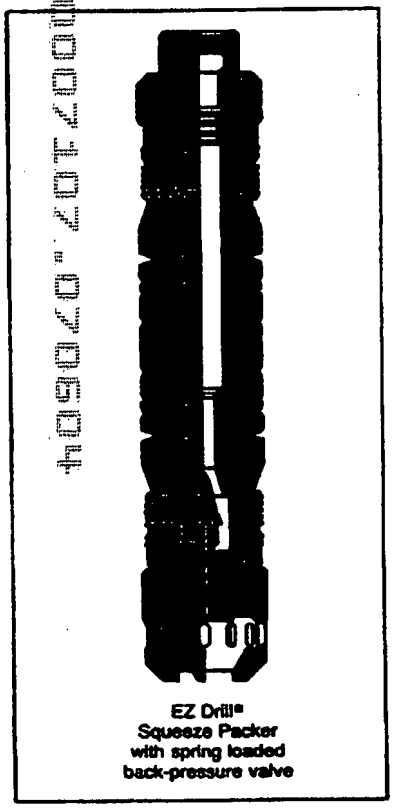
Except for the top drilling feature, EZ Drill packers offer the same design features as the EZ Drill bridge plugs.

Fluid movement through EZ Drill SV® squeeze packers is controlled with a pressure-balanced "Sliding Valve" which replaces the spring-loaded back-pressure valve. Operated by reciprocation of the tubing, the valve may be opened or closed, as desired, before and after squeeze cementing. Fluid movement through the valve will not affect its position. When the valve is in the up position, the packer is sealed against fluid or gas movement in either direction. When the valve is in the down position, fluid may be pumped through the packer or pressure may be relieved from below it. When the valve is open an unrestricted fluid passage is provided through side ports in the tool. With interlocking valve fingers not exposed to cement slurry, the sliding valve is not likely to be cemented in place.

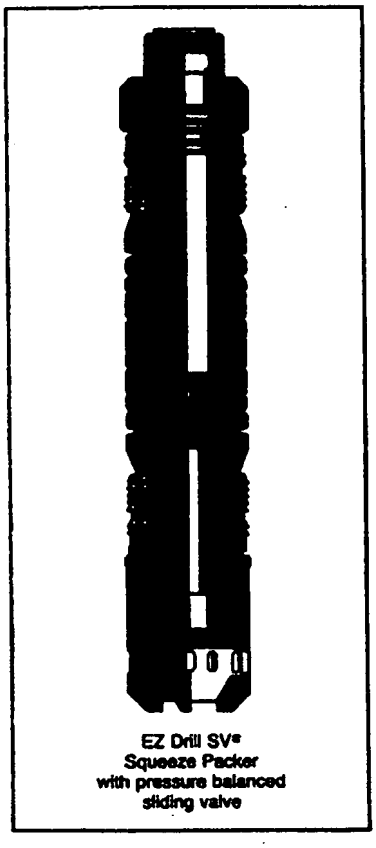
EZ Drill® and EZ Drill SV® squeeze packers may be set on tubing (drill pipe), electrical wireline, or sand line. They may be converted for use as bridge plugs (no fluid movement in either direction through the tool) before running in the hole.

EZ Disposal™ Packer

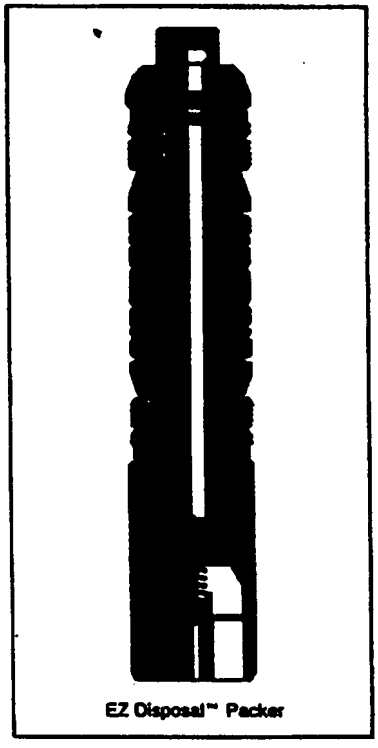
The EZ Disposal™ Packer is designed to withstand large volumes of abrasive mud, cuttings, sand, and other material pumped through the packer when disposing of mud from a reserve pit on a dry hole or abandoned well. The EZ Disposal Packer can be set on electric wireline, tubing, or drill pipe.



EZ Drill®
Squeeze Packer
with spring loaded
back-pressure valve



EZ Drill SV®
Squeeze Packer
with pressure balanced
sliding valve



EZ Disposal™ Packer

Packers

Available in 6⅝ to 13⅜ in. casing sizes, the packer contains a back-pressure poppet valve in the lower end which helps prevent re-entry of fluid from below the packer but offers little restriction of fluid movement downward through the packer. Valve face is coated with an abrasive-resistant material to withstand abrasion of fluid pumped through the packer.

Packer mandrel, lower slip support and valve components are made of cast and ductile iron to improve resistance to abrasive fluids. These components can be removed from the well casing by milling.

DESIGN FEATURES

1. High Temperature and Pressure Sealing Element. A relatively soft rubber center packer is contained between harder rubber rings and expandable metal shoes. Metal shoes expand with the rubber packer preventing extrusion of the packers over the wedges at high pressures and temperatures.
2. Smaller Tool Diameter. Design of the packer element permits use of smaller tool diameters so that only one tool normally is required for a casing size, regardless of casing weight (wall thickness). Greater clearance with casing ID lessens the chance of premature setting while going in hole and makes faster running-in speeds possible.
3. Floating Mandrel. Mandrel upon which all external parts are mounted is free to move with pressure. Forces due to well pressures, either from above or below the packer, are thus applied directly to the slips and packer element, causing the packer to set tighter as pressure is increased.

EZ Disposal Part Number	Recommended Casing Range		OD Packer Inches
	Size OD Inches	Weight Range Lb/Ft	
802.3518	7	20-38	5.50
802.3528	7⅝	20-42.8	6.12
802.3538	8⅝	24-49	7.00
802.3548	9⅝	29.3-53.5	7.75
802.3578	10¾	32.75-65.7	9.00
802.3556	11¾	42-60	9.875
802.3568	13⅜	48-72	11.66

EZ SV	EZ Poppet Valve	EZ Bridge Plug	PAC-N-PIC Bridge Plug	Size In.	Weight lb/ft	Minimum ID, In.	Maximum ID, In.	Tool OD, In.
	802.303			2⅞ 3½	6.5 16.7-17.05	2.340	2.530	2.187
802.334	802.305			3 3½ 4 4½	Line Pipe 9.2-10.3 19-22.5 26.5	2.922	3.240	2.690
802.336	802.307			3½ 4 4½	Line Pipe 9.5-14 18.8-24	3.340	3.640	3.125
802.338	802.308			4½ 5	13.5-15.1 26.7	3.826	3.920	3.590
802.339	802.309	803.639		4½ 4¾ 5 5½	9.5-13.5 16 20.3-24.2 36.4	3.920	4.184	3.660
802.341	802.311	803.641		5 5½ 6⅝	11.5-18 26-32 70	4.276	4.560	3.970
802.343	802.313	803.643		5½ 5¾ 7	13-23 22.5-25.2 64.1	4.670	5.044	4.370
802.344				5¾ 6 6⅝ 7	14 15-23 34-35 49.5	5.240	5.595	4.870
802.345				6⅝ 7	22-32 38-46	5.660	5.989	5.320
802.349	802.319	803.649	803.703	6⅝ 7 7⅝	17-20 20-38 44.6-51.2	5.920	6.456	5.500
802.351		803.651		7 7⅛ 7¾	17 20-42.8 45.3-46.1	6.501	7.125	6.120
802.353		803.653		8⅝ 8¾ 9 9⅝	24-52 49.7 45-55 71.8	7.511	8.128	7.000
802.354		803.654	803.704	9 9⅝ 9¾ 9⅞ 10¾	34-40 29.3-70.3 58.2 62.8 91	8.157	9.063	7.750
802.346				10 10¾	30.25-41.5 71-86.2	9.140	9.450	8.690
802.357		803.657	803.705	10¾	32.75-65.7	9.560	10.192	9.000
802.352				11¾	83-87.2	10.282	10.368	9.730
802.355		803.655	803.706	11¾ 11⅞	42-80.5 71.8	10.406	11.084	9.870
802.359				13⅜ 13½	80.7-100.3 81.4	11.907	12.340	11.307
802.358		803.658		13 13⅜ 13⅝ 14	40-50 48-77 88.2 92.66-119.38	12.275	12.715	11.680
802.364				16	65-109	14.688	15.250	13.940
802.366				20	133-208	17.938	18.730	17.000

Bridge Plugs

Speed-E-Line® Bridge Plug

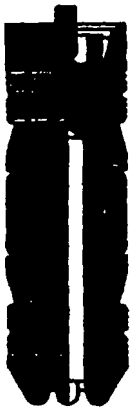
Halliburton's Speed-E-Line® bridge plug is an efficient, moderately-priced tool that is employed for permanent and drillable installations. Recommended for applications in which differential pressures do not exceed 7,500 psi (see accompanying table), it offers unmatched speed in drilling out.

This new design is useful for setting in casing as a temporary or permanent plug; it cannot be pumped through. It is used to help prevent the movement of gases or fluids from either direction; to isolate a lower zone while testing an upper section; for establishing a bridge below perforated section which is to be squeezed, cemented or fractured; to provide good pressure-tight seals for testing casing or for wells that are to be abandoned; to set in casing above zones to be abandoned and recover the upper casing.

When the top portion of this tool is drilled into, the mandrel opening is penetrated before the upper slips are reached, allowing any pressure buildup from below to bleed off and be relieved through the mandrel into the casing. This is an integral feature of the tool design and does not require an adapter.

This plug is designed primarily as a wireline-set plug, employing powder-type setting tools available through leading electric wireline service companies. In addition, a modified mechanical setting device can be employed to set the Speed-E-Line plug on tubing or below such retrievable tools as Halliburton's RTTS packer.

In order to increase dependability, the Speed-E-Line locks in set position with a ratchet. Also, the design of the packer element permits the use of smaller tool diameters so that only one tool is required for a given casing size, regardless of its weight (wall clearance). This provides greater clearance with casing ID and thus less danger of premature setting while going in hole.



Speed-E-Line Bridge Plug

EZ Drill® Bridge Plug

Halliburton's drillable bridge plug, the EZ Drill®, offers improved operating performance at higher temperatures and pressures and faster removal from a well by either rotary or cable tool drilling methods.

It runs in faster, because of the smaller OD of the tool, and drilling out time is significantly faster than comparable products. The new EZ Drill bridge plug has main structural parts composed of controlled cast iron, to enhance uniform drillability.

Important design features include:

- High temperature and pressure sealing element. This consists of a relatively soft rubber center packer between harder rubber rings and expandable metal shoes. The metal shoes expand with the rubber packer, to help prevent extrusion of the packers over the wedges at high pressures and temperatures.

Catalog Number	RECOMMENDED CASING RANGE		Max. Tool OD (Inches)	ID Lightest Weight Casing
	Size OD (Inches)	Weight Range (Lb/Ft)		
803.574	4½	9.5—13.5	3.70	4.090
803.576	5½	13—23	4.32	5.044
803.578	6⅝	17—24	5.62	6.538
803.578	7	17—38	5.62	6.538

Casing Size OD (Inches)	Weight Range (Lb/Ft)	Maximum PSI
4½†	9.5—10.5	5,000
	11.6	6,000
	13.5	7,500
5½	13 —15.5	5,000
	17 —23	7,500
6⅝	17 —24	6,000
7	17 —20	5,000
	23 —29	6,000
	32 —38	7,500

*For higher temperatures and pressures, consult your Halliburton representative.
†Can be run in 5 in. 18 lb (4.276 in. ID)—6,000 psi maximum differential pressure.

- Smaller tool diameter. The design of the packer element permits the use of smaller tool diameters so that only one tool is required for a given casing size, regardless of its weight (wall thickness). This design also offers greater clearance with casing ID and, therefore, less danger of premature setting while going in the hole.
- Top drilling. When the top portion of the EZ Drill bridge plug is drilled into, the mandrel opening is penetrated before the upper slips are reached, allowing any pressure buildup from below to bleed off sufficiently and be relieved through the mandrel into the casing. This is an integral feature of the tool's design and does not require an adapter.
- Floating mandrel. The mandrel upon which all external parts are mounted is free to move with pressure. Forces due to well pressures, either from above or below the bridge plug, are thus applied directly to the slips and packer element, causing it to set tighter as pressures increase.
- Junk pusher. The lower end of the EZ Drill bridge plug is made to help prevent cuttings and other debris from fouling the tool slips. This helps prevent premature setting while going in the hole.
- Quick removal. Each part of the EZ Drill bridge plug is designed for quick removal from the well with either rotary or cable tools, i.e.:
  - A. Material used for each component is selected for the maximum drillability permitted by its strength requirements.
  - B. Wedges, metal shoes and packer elements are locked together to help prevent their spinning while being drilled.
  - C. Slips are grooved so that they will be broken up in small pieces, which can be circulated away from the bit. The holding ability of the slips is not impaired.

EZ Drill® Bridge Plug

EZ Drill bridge plugs are designed primarily to be set on electrical wireline—or tubular goods, with necessary modifications.

SUGGESTED DRILLING TECHNIQUE — DRILLABLE SQUEEZE PACKERS AND BRIDGE PLUGS:

Best technique for drilling squeeze packers and bridge plugs will vary with available equipment, but in general, the following is suggested as a guide when drilling with rotary equipment:

Bit — short or medium tooth hard formation

Rotary Speed — 75 to 120 RPM

Weight on Bit — Apply 5,000-7,000 lb until the top end of the packer mandrel is drilled (4 in. - 5 in.) and weight can be applied across the full bit diameter, then increase to 2,000-3,000 pounds per inch of bit diameter to drill out the remainder of the packer (with 4¾ in. bit use 9,500-14,000 pounds).

Drill Collars — As required for weight and bit stabilization.

When reverse circulation is to be employed, casing scrapers should have fluid passages as large as that through the bit so cuttings will not tend to bridge at that point.

**A junk basket should be placed above the bit when normal circulation is employed.

Variations in rotary speed and bit weight should be employed to help break up the metal parts and to reestablish bit penetration should it cease while drilling. Penetration stoppage because of "bit tracking" may require picking the bit up above the drilling surface. Rapid bit contact and weight application while continuing rotation will aid in breaking up the established bit pattern and help to re-establish bit penetration.

EZ Pac-N-Pic Bridge Plug

The EZ Pac-N-Pic bridge plug is a drillable bridge plug designed for removal with a mill-type retrieving tool. The retrieving tool mills over outer components to release the bridge plug and then catches and retrieves remaining components. A "push out" equalizer in the inner mandrel bore allows release of entrapped high pressure below the plug before release of the complete tool. Fluid can be pumped down through the bridge plug after the equalizer valve has been pushed out of the packer mandrel bore and caught by the retrieving tool.

EZ Pac-N-Pic bridge plugs can be set with electric wireline or with tubing or drill pipe when a modified EZ Drill SV setting tool is used. Slips, wedges, and rubber packer elements on the Pac-N-Pic bridge plug are identical to those on EZ Drill packers and bridge plugs.

EZ Pac-N-Pic Bridge Plug

Sub-Surface Cementing Equipment

Floating, Guiding, and Self-Filling Equipment

Halliburton casing equipment is designed and manufactured to meet the requirements for guiding, floating, and cementing of casing, regardless of size or depth of well drilled. The highest degree of efficiency in cementing casing in a well is expected when Halliburton equipment is used. It is backed up by a continuous field-wide program of engineering research and development.

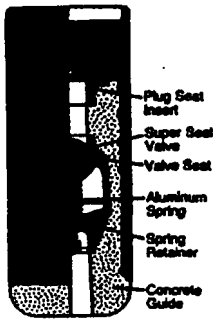
For properly guiding casing and landing it on bottom through which great volumes of fluid must be circulated, and for holding cement slurry outside casing even in the deepest of wells, essential physical qualities are included in the construction of guide shoes, float collars, float shoes, and other casing equipment.

TWO BASIC DESIGNS—Both unexcelled in physical characteristics

- Halliburton Super Seal Float Valve Assembly
- The Concrete Guide Nose—A Special Halliburton Formula

Standard Halliburton Super Seal Floating equipment is recommended for casing within its weight range through N-80 grade.

Guiding and floating equipment is made on special order for P-110 and other high grade casing and tubing. *When ordering specify casing grade, OD size, weight, and thread.*



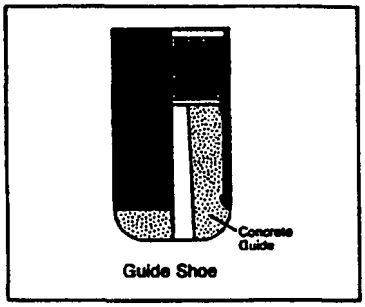
Super Seal Float Shoe

CONSTRUCTION—The valve assembly is made of a phenolic impact compound having a greater compressive strength than is normally required. It is not affected by normal well fluids because it is inert to most acids and solvents. The rubber valve cover molded on valve body is resistant to oil and wear by abrasion. *The valve spring is made of aluminum. There are no internal steel components.*

INSTALLATION—The Super Seal Float Valve Assembly is held securely in the steel coupling by surrounding it with a high compressive and shear strength concrete. The valve assembly and concrete present no difficulty in drilling out.

FLOW AREA—The fluid flow areas through the five sizes of Super Seal Float Valve Assemblies range up to 7.07 sq in. in the larger sizes. The area through the valves and concrete guide noses allows maximum pumpability for jobs even where cement or mud additives of abnormally high mixtures are required.

ABRASION BY FLOW—After pumping both mud and cement containing abrasive materials and additives for many continuous hours at high speed, the Super Seal Valve Assembly maintained a completely fluid-tight seal. *Super Sealing Effectiveness*—The design of the super seal valve makes a conical band-contact with the seat, which lowers the unit stress on the point of contact. The rubber cover on the valve helps provide a fluid-tight super seal and acts as a shock absorber for the sidewise vibration which protects the back pressure valve from wear during the pumping period. The valve spring forces the valve back up and against its seat; being very beneficial in low-pressure areas.



Guide Shoe

A shorter concrete guide nose with a more generous radius to extend from the steel coupling and made of a higher strength concrete makes Halliburton Concrete Guide Shoes and Super Seal Float Shoes more durable for guiding casing safely to bottom.

Concrete guide shoes are tested for shock resistance to run into a well under most any condition. Shear strength and shock-load resistance of concrete in Halliburton equipment provides an ample plug seat for stopping cementing plugs when pumped to a shut-off. A plug seat insert made of impact plastic is molded in the concrete of all float collars and float shoes in all standard sizes to help provide an even stronger plug seat than is provided by concrete alone.

Casing Guiding — The landing of the first joints of casing on bottom to be cemented may be hazardous. Therefore, it is safer to install a Halliburton Guide Shoe or Float Shoe on the first joint. The strong, durable, rounded guide directs the casing away from ledges to minimize sidewall caving and aids in safely passing hard shoulders and through crooked holes.

Halliburton Concrete Guide Shoes and Float Shoes are illustrated on this and following pages.

Casing Floating — Strain on a derrick caused by the weight of casing can be minimized by placing a Halliburton Super Seal Float Collar, a Super Seal Float Shoe or both on the casing to partially float it to bottom. In extremely deep wells it is well to use two Super Seal Float Collars and one Super Seal Float Shoe or two Super Seal Float Collars and a Guide Shoe on a long string of casing.

Sub-Surface Cementing Equipment

Casing flotation is accomplished when the drilling fluid is not allowed to flow upward through the float valve inside the casing. Partial weight of casing rides or floats down to bottom on the well fluid. The derrick is relieved of considerable strain.

With casing safely landed on bottom, circulation is established downward through the casing and float valve and up on the outside. After the casing cement job is completed, the back pressure valves function to keep the cement below and behind the casing.

Baffle Collar — Halliburton Concrete Baffle Collars are furnished with or without a fluid-flow opening through the concrete baffle.

A baffle collar with flow-through opening is placed in the string of casing one or more joints from bottom to help stop the Top Cementing Plug, allowing ample cement around the shoe. *Illustrated on Page 2412.*

A Halliburton solid baffle collar with cementing ports above is used with Halliburton Cement Baskets installed below to catch cement pumped through the ports to the outside for protection of a lower porous formation.

Baffle Plate—Cast Iron — A drillable cast iron baffle plate for API casing is sometimes used to act as a marker. Installed on the seat of a guide shoe, float collar seat, or one joint above the float collar, it will indicate when the drill bit reaches this point in the casing string.

Casing Shoe — A Texas Pattern Casing Shoe reinforces the lower end of the casing to minimize damage and helps it move past hole obstructions. The shoe is specially designed for use in rotary drilled wells of shallow areas, and shallow cable drilled wells where it is not necessary to guide or float the casing to bottom. *Illustrated on Page 2432.*

Tubing Guiding and Floating Equipment — Tubing floating and guiding equipment is made for all sizes and types of tubing, but must be made on special order for tubing other than API.

Float collars and float shoes for 2⅜" OD have a 1⅞" Super Seal Valve which provides a 1⅜" opening through the Valve Seat. The 2⅞" OD and larger tubing are equipped with a 2⅛" Super Seal Valve and provide an opening of 1¾" through the valve seat. These sizes of collars and shoes can be run with an automatic fill-up unit attached. These units are patterned after Halliburton casing size floating equipment and are run and operated in like manner.

The regular tubing guide shoe nose is made of drillable cast aluminum.

When ordering either float collars, float shoes, or guide shoes, it is necessary to give a complete description of the tubing as to grade, OD, upset or non-upset, number of round or sharp threads, and whether it is API or a special type.

Equipment for line pipe should be ordered by nominal size rather than OD.

Halliburton Weld-A

Halliburton Weld-A is an economical thread compound which has proved superior to tack-welding as an aid in locking threaded connections tightly and permanently on any casing string to save time and money.

Floating Equipment and the bottom two or three joints in a casing string should be secured at the couplings so that drilling can be continued through the casing string . . . and not be unscrewed by the turning of the drill pipe. Halliburton Weld-A, properly mixed and applied, is compounded to aid in providing the necessary bond to prevent these threaded connections from breaking out . . . without welding. Effective temperature range is 60°F to 320°F.

Based on actual tests, the torque required to break joints locked with this compound is greater than that of tack-welding.

Packaged in a one pound can lock approximately: four 4½" t 5½" couplings, three 7" coupling 7⅝" through 9⅝" couplings or one through 13⅜" coupling. Directio use are on each can.

Hi-Port Up Jet Guide and Float Shoes

When wells accumulate enoug tings around the bottom of the h cause a drop in pumping efficien an increase in pump pressure, Ha ton Hi-Port Up Jet Guide Shoe: Float Shoes may be installed c casing shoe joint to help remove cuttings and give the annulus a thorough cleaning.

This equipment is particularly su in areas where a large accumulati cuttings makes it difficult to dete when casing touch-down is ac plished. Hi-Port Up Jet Shoes essentially the same as regular burton Guide Shoes and Super Float Shoes and contain similar ac tages and features except that the twice as long and have high-an ports located in the side of the s These ports jet approximately 40 cent of the mud or cement upward v the other 60 per cent moves out the tom in conventional manner.

The jetting action helps remove cuttings and lowers pump press caused by plugging. It thus provid cleaner wellbore and increases tu lence during circulation and cemen When the shoe nose is seated on tom, the entire flow is channeled thro the side port jets to the annulus out the casing string.

For Thread and Coupling Informa refer to Page 2432, Ordering Infor tion.

See illustration, Page 2434.

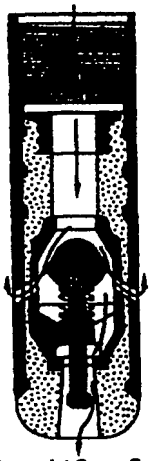
Down Jet Guide and Super Seal Float Shoes

A casing cement job to be successful depends on the condition of hole and cement slurry placed around the casing shoe and behind the pipe.

Down Jet Guide Shoes and Down Jet Super Seal Float Shoes do more than just float and guide strings of casing to bottom. Discharging fluid in volume under pressure out the side ports and through the guide nose provides a forceful jetting action. This helps remove cuttings, filter cake, and creates a turbulence around the shoe for better cement distribution.

The float shoe utilizes the dependable Halliburton Super Seal Back Pressure Valve to help prevent fluid re-entry into casing string. Design and construction provide for approximately 60 percent of fluid volume to be directed to the outside through the side ports below the back pressure valve seat and above the concrete guide nose. The side ports (size and number depend on casing OD size) are drilled through the float body on spiraled angle slanted down at 30°. Swirling fluid discharging through the guide nose causes a powerful turbulent action at the shoe joint.

Best jetting action is obtained with a large fluid volume flow rate and pump pressure.



Down Jet Super Seal Float Shoe

Down Jet Guide Shoes and Float Shoes are recommended for:

- Jetting-off and washing-out mud cake from the bottom of the hole while rotating or reciprocating pipe prior to a cement job
- Penetrating bridges when running casing
- Agitating and distributing cement to minimize channeling
- To allow circulation of fluids out through side ports with casing resting on bottom
- To jet washed-out, oversized sections of borehole

A well-agitated slurry of cement around the shoe and up several feet aids substantially in a more uniform column of cement at this point.

The Insert Float Valve with Self Fill-Up Unit cannot be run above this equipment as the orifice tube and tripping ball cannot be discharged down through the shoe.

The Super Seal Automatic Fill-Up attachment cannot be run with the Down Jet Float Shoe.

For Thread and Coupling Information refer to Page 2432, Ordering Information.

Insert Float Valve

The Halliburton Insert Float Valve is an economical float valve for floating and casing cementing operations, where a medium range of differential pressures exists. A casing Self Fill-Up unit can be attached if desired.

The float valve is installed in a casing coupling one or two joints above the guide shoe. It has the strength to satisfy most of the pressure requirements of casing jobs that do not need the high strength contained in Halliburton's Super Seal Floating Equipment.

Some additonal features of this type back pressure valve are:

- More economical than conventional types of floating equipment
- Large flow area through valve
- Dependable—easy to drill
- Fast conversion to an orifice tube Self Fill-Up unit
- Simple installation
- No length added to casing string
- May be used below Halliburton Multiple Stage Cementer
- Eliminates two threaded connections in casing string—no welding required

Insert Float Valves are designed to be installed in either long or short standard API 8-round thread couplings when run with casing having a weight included in the range stamped on the valve. Cast iron back-up rings are run with the Insert Float Valve in other sizes of the lightest weight short thread casing.

The casing OD size and weight should be given when ordering. See Data Table in current Sales Product Price List.

The Insert Float Valve is made of readily drillable cast aluminum valve seat body and flapper valve, with a flow area through the valve seat equal to Halliburton's Super Seal Floating Equipment. A rubber ring on the top side of the float seat helps provide the seal between the insert float at the point of casing make-up in the coupling. The flapper valve has a rubber sealing lip that helps provide a fluid-tight seal. A steel torsion spring helps keep the valve closed while running-in and on completion of cementing operations.

The body of the 8-round float valve is threaded and is installed in a casing coupling by means of a special wrench, No. 815.1976. Valve body is made up in the coupling until it seats on the top end of the lower casing joint or back-up ring if run in coupling. The upper joint of casing is then made up until it seats against the seal rubber on the upper side of the Insert Float Valve body.

Back-up rings are available for the casing sizes and weights listed in Data Table in current Sales Product Price List. These rings are to be placed *below* the standard Insert Float Valve when run with the casing weights listed in table.

One or more insert valves may be run in the same casing string.

Insert Float Valve

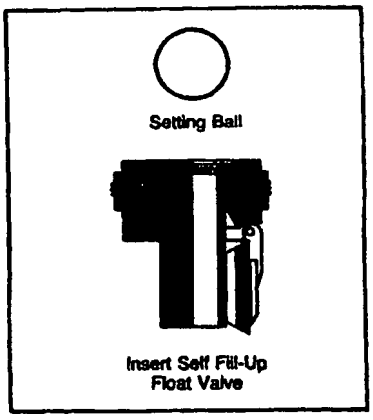
Sub-Surface Cementing Equipment

Insert Self Fill-Up Float Valve

Halliburton's Insert Self Fill-Up Float Valve is a combination of the economical Insert Float Valve (described on Page 2429) and a simple self fill-up assembly, which is a predetermined fixed size orifice tube of plastic material. This Insert Self Fill-Up Float Valve serves the same purpose and affords most of the advantages and functions of Halliburton's other types of automatic casing fill-up equipment except that its use is limited to wells where a medium range of differential pressures will be encountered.

ADDITIONAL FEATURES OF THE INSERT SELF FILL-UP FLOAT VALVE ARE:

- Circulation can be established through fill-up unit without tripping the valve
- Self Fill-Up unit may be tripped at any time by dropping a weighted plastic ball and circulating
- Both the valve and the Self Fill-Up unit operate efficiently in muds containing high percentage of lost circulation materials
- May be used below Halliburton Multiple Stage Cementer for stage cementing



Insert Self Fill-Up Float Valve

The Insert Self Fill-Up Float Valve consists of an Insert Float Valve, and Self Fill-Up assembly. The Self Fill-Up assembly is a plastic orifice tube that has a pre-selected inside diameter and is inserted through the valve body to hold the flapper valve open. The orifice tube is held in a stationary position in the float seat with a retaining snap ring on top of the orifice tube to anchor it in the valve body. Installation of the Self Fill-Up Float Valve assembly is made in the same manner as when the insert valve is used as a regular back pressure valve.

To select the size orifice tube for most efficient casing filling, the characteristics of the drilling mud, hole size, hole condition and depth should be known. A Halliburton representative will assist in making this selection.

Circulation may be established as desired, through the Fill-Up unit without tripping the flapper valve. When casing is within a few joints off bottom, the weighted plastic ball, furnished with the assembly, can be dropped in the casing to seat on top of the orifice tube in the insert valve. When casing reaches casing point, normally 500 to 800 psi pressure is applied, causing the orifice tube to shear or break out of the valve body and pump down through the guide shoe. The flapper valve then becomes active to hold against pressure from below. Only a conventional guide shoe (or Insert Valve Float Shoe) should be used below the Insert Float Valve so the tripping ball may be pumped out of the casing. If two Insert Float Valves are run, orifice tubes may be run in each valve and tripped with one ball.

A Ball Guide (as illustrated) should be used with the Insert Self Fill-Up Float Valve in 8⅝" and larger OD casing sizes


Insert Self Fill-Up Float Valve With Ball Guide

when off vertical hole deviation exists. these larger sizes a Ball Guide will the tripping ball to seat for dischargi the orifice tube from the float valve. F example—a guide is recommended f 8⅝" and 10¾" sizes when the hole d viation angle exceeds 20° and for t 13⅜" size when angle exceeds 5°.

Cementing plug seat and shut-off se is not affected by the Ball Guide whi consists of two thin aluminum half coni al sections that fasten to the Insert Val seat by two screws.

Ball Guides may be ordered from Da Table in current Sales Product Pric List.

Insert Valve Float Shoe With Self Fill-Up Unit

An alternate method for automat casing filling is provided by the Inse Valve Float Shoe with Self Fill-Up orifi tube.

This float shoe consists of a durab cement guide nose, aluminum flappe type back pressure valve, a plastic or fice fill-up tube, and the steel case i made with an 8-round casing threac The float shoe contains an orifice tube a pre-selected ID designed to hold th back pressure valve open and perm well fluid to enter casing string throug the guide nose and valve seat while lo ering casing into the well.

If bridges, large accumulations of cu tings or lost circulation materials are pr


Insert Valve Float Shoe With Self Fill-Up Unit

sent, the Insert Self Fill-Up Float Valve should be used in place of a float shoe. Locating the Insert Valve above the shoe reduces the possibility of plugging and premature shearing of the fill-up tube.

The fill-up orifice tubes cover a wide range of ID sizes and are the same as those used with the Insert Self Fill-Up Valve and should be selected in like manner.

Insert Valve Float Shoes presently available in 4½" and 5½" OD casing sizes. Other sizes are available on special order.

For Thread and Coupling Information refer to Page 2432, Ordering Information.

PDF™ Float Collar and Float Shoe

Automatically filling casing as it is being run into the well saves costly rig time over that done manually, minimizes casing sticking, and saves up to one third the running-in time. A Halliburton PDF Float Collar or Float Shoe permits fluid entry into the casing filling through the bottom to maintain a controlled differential pressure between the inside and outside of the casing being run in the hole. The speed at which casing is run into the well does not affect the operation of the fill-up valve. The differential fill tool is a combination differential fill-up unit and float collar or float shoe. In addition to providing casing fill-up, it helps protect formations from destructive high "ram effect" surge pressures as the casing is run. The tool is so designed that the hole may be circulated at any time without affecting the fill-up unit.

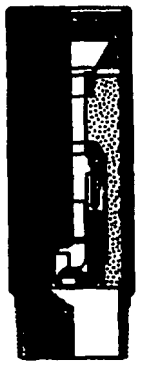
Filling action is regulated by a fill-up flapper valve riding "piggy-back" on the circulating valve. The fill-up flapper valve is regulated by spring tension which must be overcome by pressure differential causing the fill-up valve to open.

The back pressure valve can be activated at any time by dropping a weighted ball (1⅜" for 4½" through 6⅝" and 2⅜" for 7" and larger) to trip the releasing sleeve. Pump pressure of 900 to 1200 psi above circulating pressure will release the back pressure valve and discharge the ball.

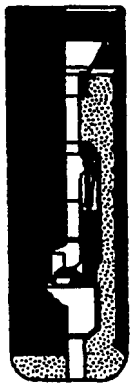
All equipment run with these tools must have an ID large enough to pass the ball used to release the back pressure valve. Super Seal Float Collars and Float Shoes cannot be run with this tool.

More than one PDF Float Collar and/or Float Shoe combination can be run in the same casing string. One tripping ball will activate the back pressure valve of all differential tools run in the casing string. The PDF Float Collar or Shoe can be run below the Multiple Stage Cementer. By-pass baffles or shutoff baffles can be installed in the top of fill-up tool.

All materials within the drift diameter of the tool are drillable.



PDF™ Float Collar



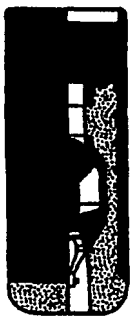
PDF™ Float Shoe

Automatic Fill-Up Floating Equipment

Halliburton Automatic Fill-Up Floating Equipment is designed to save time in running casing by eliminating frequent stops for filling pipe. This is accomplished by incorporating carefully calculated orifices in Halliburton Super Seal Float Collars and Float Shoes which meter the flow of fluids up into the pipe. A few advantages of Automatic Fill-Up Equipment are:

- Saves considerable running-in time of casing.
- Allows fluid to enter the casing with the first joint, reducing surge pressures on the formation.
- Easy to trip and may be tripped with conventional rig pump at any time desired while running casing.
- When tripped, float collar and/or float shoe is returned to a dependable Super Seal Back Pressure Valve Assembly for floating or cementing.
- Easy to operate, easy to drill and is economically priced.

A special orifice sleeve installed on lower end of the super seal valve holds the valve off the seat in an open position. With the valve off seat, the orifice sleeve that has two semi-circular orifices (fluid passages), meters the flow and allows the casing to fill from below at such rate that the fluid level will usually be held from ten to three hundred feet below the surface.



Automatic Fill-Up Float Shoe with Super Seal Valve

Sub-Surface Cementing Equipment

The same two orifices in the orifice sleeve act as a relief and are open to allow fluid to flow downward, washing out cuttings and dissipating any pressure surges developed when casing is picked up or setting into the slips.

The fill-up unit may be tripped at any time if desired. When casing either reaches bottom or is five or six joints above bottom, and if well conditions permit, the Automatic Fill-Up Unit is tripped by building up enough flow rate across the valve to shear a pin in the unit, releasing the fill-up unit, and allowing the back pressure valve to operate. *In the float collar the sleeve moves down to a lower position on the valve stem and remains there. Orifice sleeve in the float shoe drops to the bottom of the hole when pin is sheared.*

The approximate flow rate required to shear the pin ranges from 4 to 7 bbl/min. Never rely on surface pressure to release the valve. Always obtain a sufficient flow rate to shear the pin.

Even though the Automatic Fill-Up Unit may be tripped any time desired while going in the hole, its successful operation depends upon well conditions. Best results may be obtained when the following well conditions exist:

- Hole has been circulated sufficiently to remove heavy concentrations of cuttings from the mud system.
- In mud systems that have a low viscosity.
- When the gel strength of the mud is capable of carrying lost circulation material in suspension.
- In wells where the bore diameter is more than 1.75 inches larger than the OD of the casing used.
- Where the completion program calls for no more than ten reciprocating type wall cleaners within 100 feet and/or no more than thirty are used on the entire string.

Going in Hole. Valve in Open Position. Flow of Fluid Entering Casing through the Orifices.

A Flow Rate of 4 to 7 bbl/min will Shear Pins to Release Fill-Up Unit and Pump Away into Hole.

Automatic Fill-Up Floating Equipment works successfully in most areas under the above described well conditions. A Halliburton PDF Float Collar or Float Shoe is recommended for wells having high viscosity mud, heavy lost circulation material, concentrations of cuttings or numerous reciprocating wall cleaners.

For Thread and Coupling Information refer to Ordering Information below.

Ordering Information for Floating Equipment

Halliburton Casing Guiding, Floating and Cementing Equipment are equipped with threads to fit:

- 8-round casing thread with short or long threads, or slip joint casing.
- Threaded internal and external flush joint casing including casing with Hydril Type "FJ" Casing Joint, Security Flush Joint Threads, etc.
- External Upset Casing such as Hydril Type "EU", Hydril Tripleseal, Youngstown Speedtite and Armco Extreme Line.

Guide nose of a special formula concrete is standard stock in all casing guide shoes and float shoes.

State Price Reference No., OD size, grade, casing weight and complete thread specifications for accurate filling of the order.

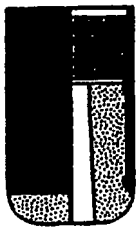
CSG. OD (in.)	WEIGHT RANGE (lb/ft)	OD (in.)	ID (in.)	CSG. OD (in.)	WEIGHT RANGE (lb/ft)	OD (in.)	ID (in.)
*4½	9.5-13.5	5.00	3.985	*9⅝	29.3-40.0	10.62	8.927
*5	11.5-21.0	5.56	4.455	**9⅝	43.5-53.5	10.62	8.619
*5½	14.0-23.0	6.05	4.907	***10¾	32.7-55.5	11.75	10.056
*6⅝	20.0-32.0	7.39	5.944	***11¾	42.0-60.0	12.75	10.948
*7	17.0-23.0	7.65	6.433	***13⅜	48.0-72.0	14.38	12.579
*7	23.0-38.0	7.65	6.261	***16	65.0-84.0	17.00	15.082
*7⅝	24.0-33.7	8.50	6.920	*20	94.0-106.5	21.00	18.956
*8⅝	24.0-44.0	9.62	7.992	*20	133.0	21.00	18.730

* Some weights of API 8-Rd casing may be obtained with either SHORT or LONG couplings. Sufficient length is provided on the male thread end of these sizes of Halliburton 8-Rd thread equipment so that long API 8-Rd male threads can be machined, if desired. Female threads will accept API 8-Rd long male threads without reworking.

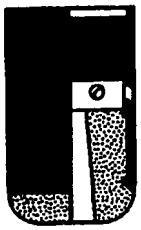
** These weights of API 9⅝" 8-Rd casing are equipped with LONG couplings only.

*** These sizes of API 8-Rd casing are equipped with SHORT couplings only. API Buttress and API Extreme Line can be furnished.

Guide Shoes



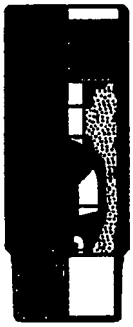
Regular Type with Cement Guide. Female threads to Fit Standard API Casing.



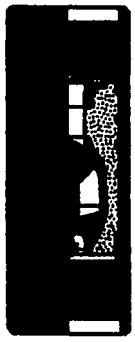
Down Jet Type with Cement Guide. Female threads to Fit Standard API Casing.

Texas Pattern (short) Casing Shoe — Open End. Female Threads to Fit Standard API Casing

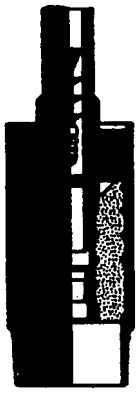
Float Collar



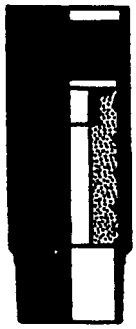
Standard Float Collar with Super Seal Valve. Male and Female Threads Made to Fit Standard API Casing.



Float Collar with Super Seal Valve. Double Female Threads Made to Fit Standard API Casing.

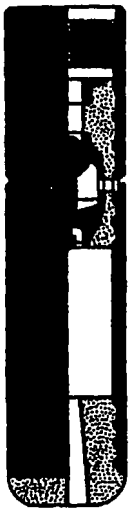


Cement Baffle Collar with Latch-Down Plug and Sealing Sleeve—for Cementing Large Diameter Casing, Male and Female Threads Made to Fit Standard API Casing.

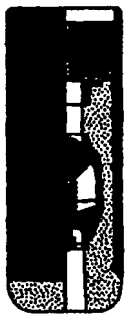


Baffle Collar— Cement Baffle with Hole. Male and Female Threads Made to Fit Standard API Casing. (Also Available with Solid Cement Baffle — Type H or Type H-1 with Portholes).

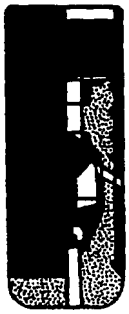
Float Shoes



Hi-Port Up Jet Type—Super Seal Valve—Cement Guide. Female Threads Made to Fit Standard API Casing.



Regular Type Super Seal Valve—Cement Guide. Female Threads Made To Fit Standard API Casing. Insert Valve Type with Cement Guide available. Shown on Page 2430.



Down Jet Cement Type—Super Seal Valve—Cement Guide. Female Threads Made To Fit Standard API Casing.

Latch-Down Plugs and Baffles

For Casing

The Latch-Down Casing Plug and Baffle may be used above most conventional floating equipment to help control fluid and pressure from below. Prevention of fluid entry into the casing string also permits immediate release of surface pressure when the cement column has been pumped to place. Additionally, the latch-down feature helps assure that the cement or top plug will not back up the casing which might necessitate drilling out if completions are made close to the flat collar.

The 3W top cement plug is molded around a drillable mandrel, containing a snap ring and rubber seal element. The baffle is of drillable material and is undercut to receive the snap ring on the plug nose.

The baffle is installed either on top of the float or in the desired casing collar above and held in place by the pin end of the casing. A rubber gasket seals against the upper joint and the coupling threads. The latch-down plug acts as the top cement plug and follows the cement slurry down the casing to reduce the possibility of contamination or channel-

Latch-Down Casing Plug and Baffle

Casing Size OD (Inches)	LATCH-DOWN CASING PLUG (Cast Iron Nose)		LATCH-DOWN BAFFLE (Cast Iron)	
	Cat. No.	Length (Inches)	Cat. No.	Baffle ID (Inches)
4½	801.0373	10.17	801.03734	2.375
5½	801.0374	10.65	801.03743	2.875
7	801.0376	10.92	801.03763	3.800

4090-20-20070005

SALES TECHNICAL PAPER

SUCCESSFUL DRILL OUT OF SHOE JOINTS WITH PDC BITS

by
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and John C. Sherril, Smith International, Inc.

SPE/IADC 27008

S-6107

Drill Out of Shoe Joints With PDC Bits

Introduction

The most important innovation in drilling technology over the last 20 years has been the development of Polycrystalline Diamond Compact bits. Polycrystalline Diamond Compact bits, commonly known as PDC bits, have proven superior to conventional bits in rate of penetration, length of service, or in short, economics. To enhance the advantage PDC bits have over conventional bits, manufacturers are seeking ways to make PDC bits more universally acceptable. One capability bit manufacturers have recently sought for PDC bits is to drill out casing shoe joints, then continue drilling into formation. To do this, PDC bits must be able to drill out five-wiper cementing plugs and floating equipment without damage to the bit and without taking an excessive amount of time. A series of drill out tests has recently been completed to evaluate the drillability of casing cementing equipment. In addition, drill out tests of a recently designed non-rotating cementing plug set and float collar were also performed.

PDC Bit Basics

The most identifiable feature of a PDC bit is its large number of sintered polycrystalline diamond studs on a single piece body. Typically 25 to 75 studs are found on a PDC bit, though the number varies with bit size. Normally, each stud is 0.5 in. (13.3 mm) in diameter although recent developments have made much larger studs available. The structure of each stud is usually the same: a 0.025 - 0.030 inch (0.63 - 0.76 mm) thick layer of sintered diamond is formed onto a 0.115 - 0.140 in. (2.92 - 3.56 mm) thick substrate of tungsten carbide. Each of these wafers are then brazed onto either a tungsten carbide stud or cylinder. These likewise are then brazed or pressed into a steel or tungsten carbide matrix body.

Due to the diamond cutting elements and design parameters, PDC bits typically penetrate rock more quickly then conventional roller cone bits. The increase in penetration is due to the mechanism of failure of the rock. Conventional roller cone bits crush the rock, then rely on hydraulics to flush the debris from the wellbore. PDC bits, on the other hand, shear the rock with the diamond layer on each stud.

The structure of PDC bits allow them to be tailored to a given formation. The types of formations which PDC bits are well suited range from soft, sticky formations (IADC Code 111) to medium hard formations (IADC Code 517). The structure of PDC bits can be described by features such as bit profile, cutter density, cutter placement, cutter exposure and bit hydraulics. Bit profile describes the geometrical surface which contacts the formation. Some profile types include concave, convex, stepped, full round, long taper, short taper, and parabolic. Cutter density refers to the number of cutters per unit area of bit diameter. Cutter placement describes where each cutter is located on the bit face. Each cutter is located on a separate diameter such that in a single revolution, 100% of the formation face is contacted by the cutters. Cutter exposure relates to the distance from the cutting edge of the stud to the body of the bit. And finally, bit hydraulics are extremely important as the flushing of debris sheared by the bit must take place. If cuttings are left behind, the effectiveness of the bit is diminished. To aid in the flushing of debris, most bits have gage reliefs or junk slots cut into the side of the bit body. Turbulent jetting flow through the bit is normally achieved with nozzles and is required to keep the cutting area clean.

Although PDC bits can outperform conventional roller cone bits in many applications, they are not without their weaknesses. Because the diamond surface of each stud is so hard, they are inherently brittle. Impact with hard materials such as steel or cast iron (which are present in some types of casing equipment) can cause major damage to the cutters. PDC bits are also unstable when subject to high temperatures. Frictional heat build up can become excessive if the cutters are not

sufficiently cooled through circulation. These factors make PDC bits unsatisfactory for use in inhomogeneous nations. They also make PDC bits a poor selection for drilling floating equipment containing cast iron flapper valves or steel springs. Use in these applications can cause wear, or more likely, damage to the point of limiting the economic benefit of the bit.

The key to success for PDC bits is economics. Of great interest to the driller is the cost per foot of hole drilled. With the cost of PDC bits running up to five times that of conventional bits, it is easy to see that there must be some outstanding performance records to offset bit costs. The following equation provides a cost analysis frequently performed by the driller:

$$CPF = \frac{BC + HRC\,(TT + DT)}{FD}$$

where CPF = cost per foot of hole drilled
BC = bit cost
HRC = hourly rig cost
TT = tripping time
DT = drilling time
FD = footage drilled

With their much higher cost, PDC bits must require fewer trips, have higher penetration rates, or drill more footage without being replaced, in order to compete with conventional bits.

Bit manufacturers are constantly seeking ways to further extend the economics of using PDC bits. Their concentration has focused on the drilling out of casing shoe joints and continuing their drilling program. By drilling out the shoe joint the cost of an entire trip can be avoided. In the past, PDC bit manufacturers have been reluctant to drill out shoe joints for fear of damaging the bits on the metallic components found in some floating equipment. As a result, they frequently recommended drilling out the shoe joint with a conventional bit, then tripping in a PDC bit to continue their drilling program. Bit manufacturers and casing equipment manufacturers are now working together to determine the drillability of casing equipment with PDC bits.

The three 8¾ in. (222.3 mm) PDC bits used in the drill out tests were (1) a concave or flat bottom bit containing 42 each 0.50 in. (13.3 mm) cutters, (2) a convex profile bit containing more than 50 each 0.50 in. (13.3 mm) cutters, and (3) a semi-parabolic profile bit containing 16 each large 0.75 in. (19.1 mm) diameter cutters and 4 each 0.50 in. (13.3 mm) gage cutters. The convex profile bit is frequently used in North Sea operations. The semi-parabolic profile bit is used predominantly in soft sticky formations, such as those found in the US Gulf of Mexico. All three bits used four 13/32 in. (10.3 mm) nozzles during testing. For the purpose of this paper, these bits will be designated 1, 2, and 3 respectively.

Casing Cementing Equipment

Casing equipment evaluated during these tests included float collars and five-wiper cementing plugs containing both plastic and aluminum inserts. In addition, a newly developed non-rotating five wiper cementing plug set and mating float collar were tested. An understanding of the construction of each of these items is as important as understanding the composition of formations to be drilled; these topics will be addressed in subsequent paragraphs.

Floating equipment chosen for this series of tests consisted of float collars for 9⅝ (244.5 mm) 8RD, 29.3-40 lb/ft (43.6 - 59.5 kg/m) casing. The back pressure valve used in these float collars was poppet type. Back pressure valve materials included an all plastic body, composite plastic, aluminum, and rubber poppet, and an aluminum spring and spring retention cap. The valve was supported in the float collar with a fine aggregate concrete having a minimum compressive strength of 10,000 psi (68,948 kPa).

Two types of five-wiper cementing plug sets were tested. These were plastic inserted top and bottom plugs, and aluminum inserted top and bottom plugs. Characteristics of these plugs are similar. They each have five wipers which are used to clean the inside diameter of the casing and inserts which provide rigidity to the plug. The outside diameter of the inserts is sized such that the plug can readily be used in the heaviest weight casing for its size.

The insert must also be small enough so that the wipers have the flexibility to effectively wipe the inside of the casing. Inserts used in bottom plugs are hollow cylinders and are capped on one end with a fabric reinforced diaphragm. The diaphragm provides a temporary barrier between the well fluid and cement being displaced. When the bottom plug lands at the float collar the diaphragm bursts, allowing the cement to be pumped out through the shoe joint to the casing annulus. The inserts used in the top plugs are either hollow cylinders which are solid on one end, or they are flat discs. Top plug inserts provide a solid barrier between the cement and displacing fluid. For these tests the inserts were all cylindrical except for the top aluminum plug, which contained a disc-shaped insert.

The plastic inserted, non-rotating plug set and mating float collar were all similar to the conventional equipment described, with the exception that mating surfaces between the float collar and bottom plug and bottom plug and top plug contained a non-rotational mechanism. The non-rotational mechanism is made

from plastic and contains 20 teeth. Each tooth widens it progresses from the axis of the plug. Because each tooth is diverging, it is assured that when enmeshed with its mating part, there is no clearance. Therefore, the maximum amount of rotational resistance is obtained when subjected to a torque loading. Because the enmeshing components have the same profile, it is possible to land just a top plug against the float collar if a bottom plug is not desired.

Goals of Tests

The goals of these tests were threefold.

1. Determine drillability of the casing equipment with PDC bits. The floating equipment tested contains aluminum components which most bit manufacturers consider PDC drillable, although a few have expressed concerns based on previous experience.
2. Develop a recommended procedure to be used when drilling out casing equipment.
3. Evaluate the drillability of the non-rotating cementing plug set and float collar.

To achieve these goals a series of drill out tests were proposed using three PDC bits supplied by Smith International, Inc. In the first series of drill out tests, only 9⅝ in. (244.5 mm) float collars were used. The second series of tests was to drill out a 9⅝ in. (244.5 mm) plastic inserted top and bottom five-wiper cementing plug set cemented in place on top of a 9⅝ in. (244.5 mm) float collar. The third series of tests performed was similar to the second except 9⅝ in. (244.5 mm) aluminum inserted top and bottom five-wiper cementing plugs were used. The final series of tests was to drill out a 9⅝ in. (244.5 mm) plastic inserted non-rotating five-wiper cementing plug set cemented on top of the mating float collar.

Drill Out Parameters

Three drill out parameters were continually monitored during the drill out tests. They were weight on bit, rotational speed, and circulation rate. These parameters along with the bit type determined the bits ability to penetrate its drill out target. The weight on bit ranged from as little as 1000 lb (453.6 kg) to as much as 6000 lb (2721.6 kg) during testing. Excessive bit weight when drilling out shoe joints can promote shoe joint failure as well as damage the bit. Rotational speed of the drill string ranged from a low of about 40 RPM to a maximum of approximately 110 RPM. The rotational speed used during the majority of testing was kept to 60-70 RPM. Too much rotational speed can also promote shoe joint failure as well as interfere with the technique required to drill out the casing equipment. The circulation rate ranged from a low of about 84 gal/min (0.318 m^3/min) to a maximum of about 336 gal/min (1.272 m^3/min). Insufficient circulation during drilling is detrimental for two reasons. First, low circulation rates will not remove the drilled up materials from the bit face. And second, low circulation rates may allow heat buildup which could damage the cutters. Most drilling was performed with a flow rate of between 294 (1.113 m^3/min) and 336 gal/min (1.272 m^3/min). The fluid medium used during all testing was a 12.2 lb/gal (1.462 kg/liter) fresh water mud.

Drill Out Results

The first test performed with each bit was to drill out two float collars cemented in place within 9⅝ in. (244.5 mm) casing. The goal of these tests was to determine the drillability of the float collars. Bit 1 drilled through each of its targets in approximately 35 minutes each. Bit 2 required slightly less than 25 minutes and Bit 3 required only 12 minutes to drill through each float collar. Results from these tests are not surprising considering the cutter density of each bit. The semi-parabolic profile bit (Bit 3) had the highest unit load per cutter and consequently cut through the float collars in the least time. The next best times recorded were with the convex profile bit (Bit 2). Its cutter density at the bit face is less than the concave bit making it able to remove material more quickly. All three bits drilled through their targets with a minimum of damage to the bits. The most severe damage was incurred by the convex profile bit (Bit 2). The damage was limited to chipping on the three centermost cutters; upon inspection by the bit manufacturer, the damage was deemed negligible and the integrity of the bit was not impaired.

The next two series of tests were used to drill out top and bottom five-wiper cementing plugs with both plastic and aluminum inserts. All tests were conducted with the plug sets cemented in place on top of a float collar. A variety of results were obtained from these tests. Drillout times ranged from 1½ to nearly five hours. The variety was due to the different bits used, the different procedures followed, and the drilling parameters which were frequently changed. Anytime drilling progress stalled, one or more of these parameters were changed. It was during these tests that the frustrations of the driller trying unsuccessfully to drill out a casing shoe joint were experienced.

During these tests, observations were made which confirmed problems frequently reported by drillers. Probably the most common reason for excessive drill out times is the rotation of the cementing plugs in relation to each other and to the floating equipment. Proof of this phenomenon was observed when returns of soft tacky rubber were obtained. The cured rubber of the plugs, when subjected to heat buildup from friction and abrasion, decomposes into a soft, tacky form similar to

raw n or. Not only were returns of this nature observed, but also fragments from the reddish colored bottom plug were returned where the contacting surfaces between the plugs were scorched. The causes of plug rotation are functions of two factors. First, insufficient cement placed around the top plug can allow it to spin freely. If a given volume of cement, perhaps 10 ft (3.05 m) of volume or more within the casing, is placed around and above the top plug the chances of that plug being held securely in place during drill out is increased. The second factor is one of the drill bit type. PDC bits are aggressive by nature. The rather large studs can quickly engage materials such as soft rubber. Consequently, if an aggressive approach toward drill out is followed, the bits are likely to seize the plugs and cause them to spin freely with the bit. These problems were successfully overcome in subsequent tests by easing into the plugs slowly during drilling as opposed to attacking the plugs.

Another observation made during this phase of testing was that insufficient attention being paid to the clearing of the bit can also cause excessive drillout times. If concerned strictly with penetration rates, it is possible for there to be an accumulation of debris from the cementing plug around the bit. The accumulation of debris has the same effect as the spinning plug. The debris found was not the typical small cutting as one might expect, but the rubber wipers from the plugs. What became apparent by studying the returns was that PDC bits can readily drill through the plug bodies but they have difficulty drilling up the wipers. The longer drillout times in these tests were recorded where evidence of spinning and insufficient clearing of the bit face were observed.

Of these tests, the most successful were where a deliberate regimen was followed. In this, lighter weights and frequent flushing of the bit were used. The frequent flushing of the bit appeared to be the most beneficial of the two. By flushing after each 1 to 2 in. (25.4 - 50.8 mm) increment of penetration or when penetration had stalled, the buildup of plug wipers and miscellaneous chunks of rubber from the plugs was minimized. Consequently, each time weight was reapplied, the bit was drilling new material. The flushing performed was a combination of maintaining the circulation rate while reciprocating the drill string 3-4 ft (approximately one meter). If excess material was still sensed under the bit by the driller reciprocation of up to 15 ft (4.6 m) was sometimes found helpful.

Another observation made during these tests was that aluminum inserted cementing plugs should not be drilled out with PDC bits. Although the aluminum itself is drillable, the inserts were found to break into rather large pieces, which were torn free from the rubber during drilling. The large pieces could cause severe damage to the bit due to impacts with individual cutters. Although none of the bits were severely damaged during all of the tests, the most significant damage occurred when drilling up the aluminum inserted plugs. The nature of the damage ranged from chippage of a few cutters to shearing off segments of several studs to imbedding chunks of aluminum between cutters. None of these types of damage would be deemed acceptable risks for using aluminum inserted cementing plugs. In comparison, damage to the bits when drilling out the plastic inserted bits was inconsequential. The damage was limited to a slight amount of chippage.

Drill Out of Non-Rotating Plugs

Three drill out tests were performed utilizing plastic inserted non-rotating plug sets and float collars. The convex profile bit (Bit 2) was used for two of these tests and the semi-parabolic bit (Bit 3) for the third. The results of these tests confirmed the capability of the non-rotating mechanism to prevent the plugs from rotating in relation to one another or to the float collar.

During the first of these three tests, an important lesson was learned: nozzles are a very effective means of removing cut material. The nozzles were inadvertently left out of the bit at the outset of the test. Until the missing nozzles were discovered, penetration into these plugs was disappointing. Once the nozzles were installed and the debris cleared from the bit face, drill out proceeded rapidly. The ineffective removal of debris and its associated limit on penetration rate illustrate an important feature of PDC bit hydraulics. While the same circulation rate was maintained before and after the installation of the nozzles, the jetting action created by the nozzles was required to remove the debris. The jetting turbulence and velocity created by the nozzles are requisites for effective penetration of shoe joints. Examination of the returns from this test proved the effectiveness of the non-rotating feature of the plugs.

The time required to drill out the second set of non-rotating plugs was only 1½ hours. During this test, penetration was limited to approximately 2 in. (50.8 mm) for any given interval. Penetration was followed by 30-45 seconds of flushing the debris from around the bit while reciprocating the drill pipe. If penetration stalled at any point an interval of flushing was again undertaken. As in the first test, returns proved that the non-rotating feature of the plugs did indeed prevent the plugs from spinning in relation to each other.

The third drill out test was performed using the semi-parabolic bit (Bit 3). At the outset of this test, the most rapid penetration during all of the testing was observed. Consequently, drilling was continuously performed without flushing. Within 15 minutes, returns from the bottom plug were seen. The returns also indicated once again that the plugs were not spinning one

relation to the other. After 15 minutes, however, penetration came to a standstill. For nearly two hours intervals of flushing and drilling were continued without progress. Several times within this time period it was noticed that debris had fallen on top of the target. Reciprocation was also hindered by debris around the bit. The bit was retrieved for inspection. When pulled from the casing an entire wiper was found around the bit. The wiper effectively sealed the annulus around the bit and prevented clearing the bit face of debris. Once removed, drilling of the bottom plug and float collar was completed in about 40 minutes.

Drill Out Recommendations

The following recommended procedure for drilling out casing shoe joints was formulated based on the results of these test.

1. Apply a thread locking compound to the last four to six casing thread connections and to the floating equipment threads. This will help prevent the shoe joint from backing off during drillout.
2. Release the top cementing plug while still pumping cement. Allow for at least 10 ft (3.05 m) of cement to be located above the top plug at the conclusion of pumping.
3. When drilling out casing shoe joints with PDC bits, use only plastic inserted five-wiper plugs and PDC drillable floating equipment. Non-rotating cementing plugs are recommended as a way to prevent plug rotation during drill out.
4. These tests have shown that 60 to 80 RPM, with no more than 6000 lb (2722 kg) weight on bit produces the best results for drilling the shoe joint. A circulation rate of 5 to 10 gal/min (0.019 - 0.038 m^3/min) per square inch of bit area will rapidly remove most material from the bit face. Allow the weight on bit to drill off prior to applying additional weight.
5. Penetration in the shoe joint should be limited to 2 in. (50.8 mm) or less. Before continuing, the bit should be reciprocated while continuing circulation and rotation to help clear debris from the bit. Maintain the same bit speed during this operation. Whenever penetration stops prematurely, repeat this step until penetration resumes. This step is especially helpful in removing cementing plug wipers as they are drilled up.
6. If the drill pipe and/or rotary table should start to jump, back-lash, or act erratically, temporarily change one or more of the following drillout parameters: weight on bit, bit speed, or circulation rate. Resume drilling with original parameters once normal operations are observed.
7. If the penetration rate ceases and cannot be reinstated using the above procedures, it would be advantageous to recover the bit for inspection.

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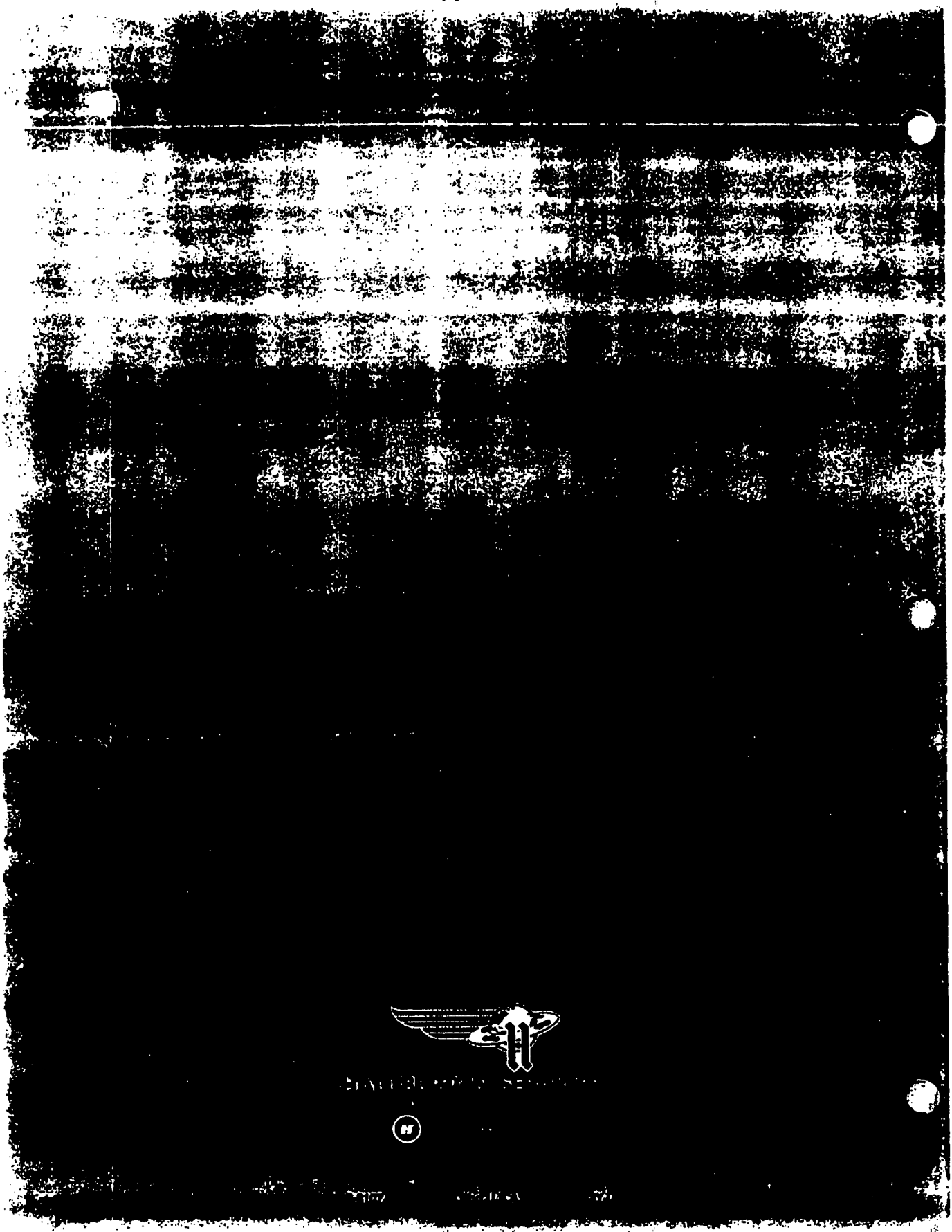

Fundamentals of Drilling

—Technology and Economics

John L. Kennedy

PennWell Books
PennWell Publishing Company
Tulsa, Oklahoma

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This book is dedicated to the following persons, listed in the order of their initial influence on my life:

Russell and Wilma
Barbara
Patty
Jane
Anne

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rock; but they also require more energy input. Another factor that has kept these techniques from being put to commercial use is the need for significant modifications of surface equipment.

While these techniques are under study and development, there are still incentives for improving the efficiency of the rotary drilling system, especially in deep holes. Drilling rate generally decreases as well depth increases. One reason is that the pressure of the mud column increases with greater depth, increasing rock strength and inhibiting the removal of rock chips from beneath the bit. Poor removal of cuttings also results in the bit regrinding some rock chips that have already been removed. This uses energy that could otherwise be used to remove new rock chips.

Increasing the power than can be transmitted to the rock is an overall goal of much drilling research. Increasing it within the confines of the power available on a conventional rotary rig is the goal of drilling engineers, drillers, and anyone connected with drilling an individual well.

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4 Drilling Bits

It is difficult to single out any one compone rotary drilling system as the heart of the operation. But the drilling bit is certainly one of the most in items of equipment. It has a significant effect on the cost of dri well. Selecting the proper bit for each section of the hole direct ences how fast the hole can be drilled and how severe downhole p may be.

The number of bits used in a single well varies widely, depe depth, the type of formations encountered (hard or soft), drilli lems that may occur, and other factors. Under good conditi proper bit may be able to drill several hundred feet before havi replaced, or it may drill only a few feet when a very hard or a formation is encountered.

After the bit is in the hole, it is important that the weight on and the rotating speed for which it was designed be used. Pr weight and rotating speed are as important for efficient drilli proper bit selection. The correct bit for the formation, if used i erly, will have a shorter life and drilling costs will be higher.

Care is also necessary when lowering the drill string with attached into the hole or removing the bit from the hole. Lack during trips in and out of the hole may damage the bit, even re in a fishing job if part of the bit is broken off and remains in the h broken bit must be fished from the hole, drilling cannot proce the junk is removed. This may take only hours, but it can also tak days. If a bit is damaged on the trip into the hole and does n properly—even though it may not be broken and have to be fishe time required to complete the extra trip out of the hole and back i a new bit is costly.

Many operations are required to complete an oil or gas well that involve actual drilling. But contractors and operators are alway

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ing to increase the amount of time spent with the bit on bottom. A certain number of trips to change bits is necessary because there is an optimum length of time for drilling with an individual bit. This optimum is determined by considering how fast the bit is drilling as it wears, the bit cost, and the cost of a trip to replace it. But unnecessary trips, fishing jobs, and other interruptions in actual rotating-on-bottom time increase the cost of the well.

Types of bits

Since the advent of the rolling cone bit in the early part of this century, much of the oil and gas well drilling done by rotary rigs has been done with this bit. The general configuration of the three-cone rolling cutter bit has changed little since its introduction. But the development of better cutting surfaces and much more durable bearings has kept pace with the demands of the drilling industry.

The most common rolling cone bit is the steel-tooth or milled-tooth bit, in which the teeth are milled on each cone (Fig. 4–1). The cones are mounted on shafts on the legs of the bit body, offset to increase cutting action, and bearings insure free rotation of the cones on the shafts.

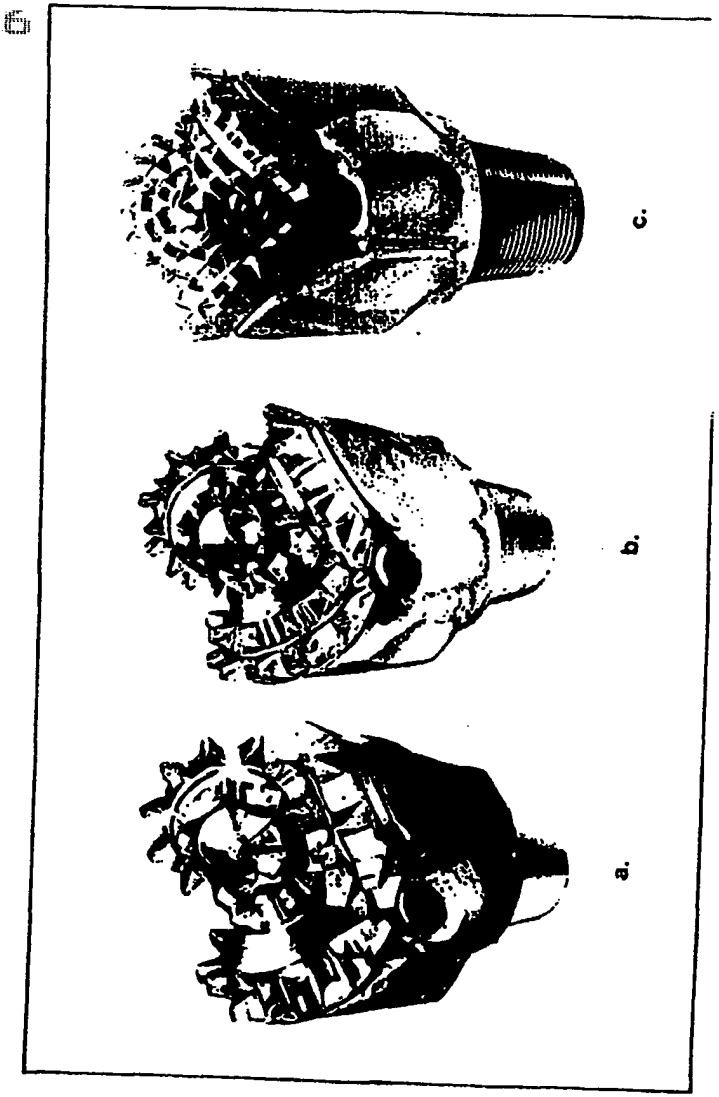
In the early 1950s, the insert bit was developed for drilling hard, abrasive formations. The insert bit has tungsten carbide inserts mounted or inserted in holes in the cone rather than having teeth milled on the cone. The rest of the insert bit configuration is similar to that of the milled-tooth bit—the cones turn on shafts fitted with bearings (Fig. 4–2).

Throughout the development of rolling cone bits, manufacturers have tried to maintain a fairly close balance between expected life of the bearings and expected life of the cutting structure. Either bearing failure or a worn cutting structure means the bit must be replaced. A bearing that lasts significantly longer than the cutting structure is, therefore, of little practical value. And the reverse is also true.

The carbide insert extended the life of the cutting structure. The next key development in the rolling cone bit was the sealed bearing. The seal and lubrication system protected the bearing against the entry of drilling fluid and maintained a clean environment for the bearing.

This combination of a carbide cutting surface and a sealed bearing extended bit life dramatically. Still, the carbide insert bit was applicable primarily in only the harder formations. In the mid-1960s, efforts were made to extend the application of carbide insert bits into medium-hardness formations, but greater bearing life was still needed.

In the late 1960s and early 1970s, the O-ring sealed journal bearing bit



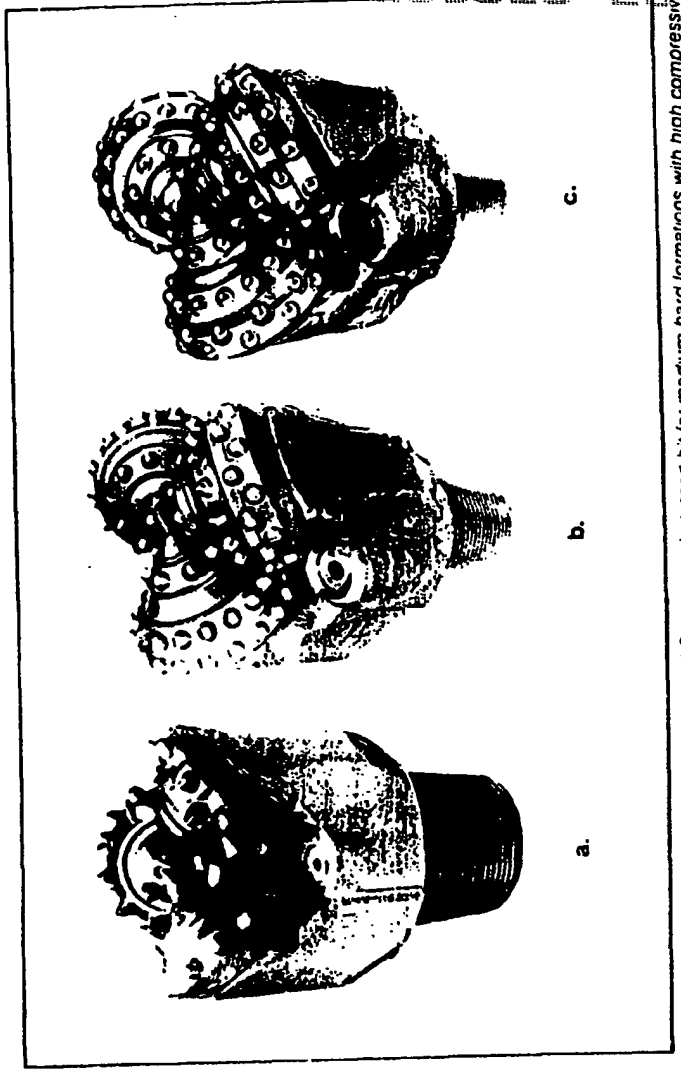


Fig. 4-2 a) Insert bit for very soft formations, b) Recommended insert bit for medium-hard formations with high compressive strength, c) Insert bit for hard, abrasive formations. (courtesy Hughes Tool Company)

was made commercial. This new bearing further increased bearing and made it possible to design carbide cutting structures for medi and soft formations. Today, carbide bits are applied over a wide r formation types and hardnesses.

Another adaptation of the rolling cone bit is the two-cone, extend nozzle bit, designed especially for soft formations. The two-cone carb insert bit recently developed uses two extended nozzle tubes for bet bottom-hole cleaning and a center jet to resist bit balling. In additio better bit cleaning in soft formations, the design reportedly has sh promise in areas where wells tend to deviate from vertical wl drilling—crooked-hole country—because a relatively high penetrat rate can be maintained while running at lower bit weights.[1]

In general, lower bit weights tend to maintain a straighter hole. with most bit designs, penetration rate drops off significantly when weight on the bit is reduced.

Diamond bits also drill a significant amount of footage in the oil gas industry (Fig. 4-3). A diamond bit has many small indust diamonds set in a steel matrix and has no moving parts. Historic used to drill harder formations and in other special situations wh very low drilling rates are involved or extra-long bit life is requi diamond bits can also be an alternative to the three-cone rotary bi many routine drilling operations.

As is the case with many bit designs, the range of applicatio diamond bits continues to increase. Rather than being a specialized t for use in very hard formations and with downhole drilling mot diamond bits are now being used more and more for nonspeciali drilling applications. According to one source, the key to their appli tion, as is the case for most bits, is penetration rate.[2] Conclusi reached from one group of field tests indicate that diamond bits sho be considered as an economic alternative to three-cone bits when pe tration rates fall below 10–12 ft/hour.

Other types of bits for use with the rotary rig are also available. (relatively new development is the use of polycrystalline diamond c pacts in a drag bit designed to drill soft to medium-hard formations (F 4–4). Such a bit is similar in operation to a conventional drag bit in t rock is removed by scraping action. The new bit's teeth protrude fr the bit face much more than do the diamonds in a diamond bit, givin the ability to drill softer formations without becoming clogged. Us these new bit type is expanding rapidly to a variety of drilling appli tions.[3]

Other types of bits are under development and have not yet b applied routinely in the field. One example is the core crusher bit. T

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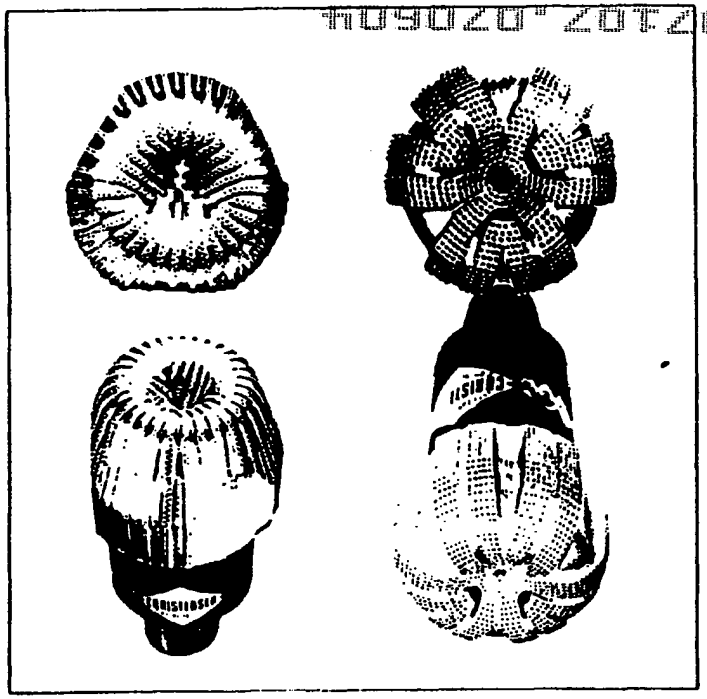

Fig. 4–3 Diamond bits (courtesy Petroleum Diamond Products Division, Christensen Diamond Products USA)

diamond bit is designed with a central part like a coring bit. As the bit drills, a core is formed at the center that is broken and then crushed in a chamber located above the bit. The design was aimed at overcoming the fact that in conventional diamond bits a core is formed under certain conditions and removal of cuttings in this core tends to slow penetration rate. Some field testing has been done with the bit and more is planned.

Developments in bit design are aimed at either increasing the life of the bit or making it cut faster. Increasing bit life reduces the number of trips that must be made to replace the bit; drilling faster is an obvious advantage. Both goals of bit development reduce overall drilling cost.

Another approach to reducing the number of trips to replace the bit is

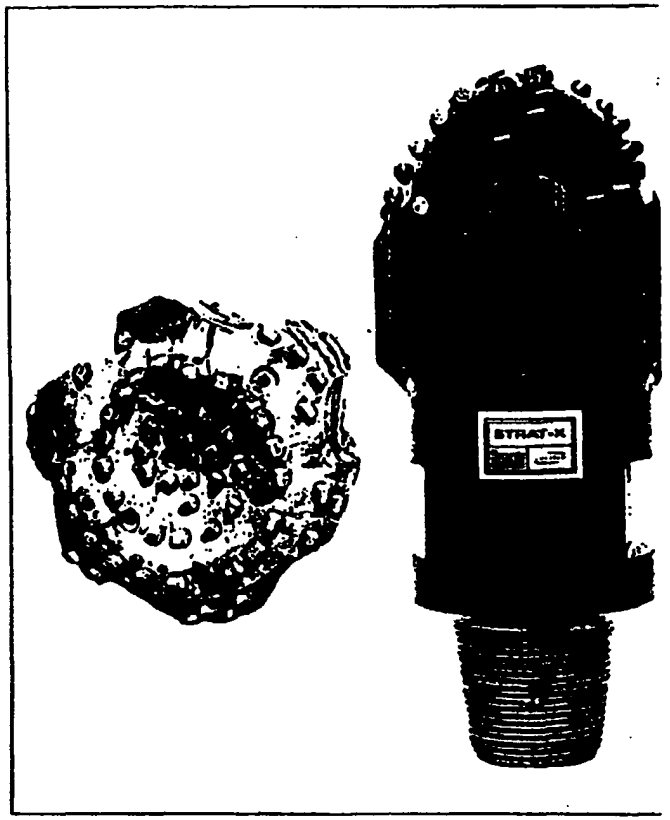

Fig. 4-4 Polycrystalline diamond compact bits. (courtesy Security Division, Di Industries, Inc.)

the continuous-chain drilling bit (Fig. 4–5).[4] It was developed as p. the Department of Energy's geothermal well technology program objective of the work was to develop and demonstrate in the field a rock diamond bit capable of replacing the rock cutting structure d hole.

The continuous-chain bit developed in this program contains 1(

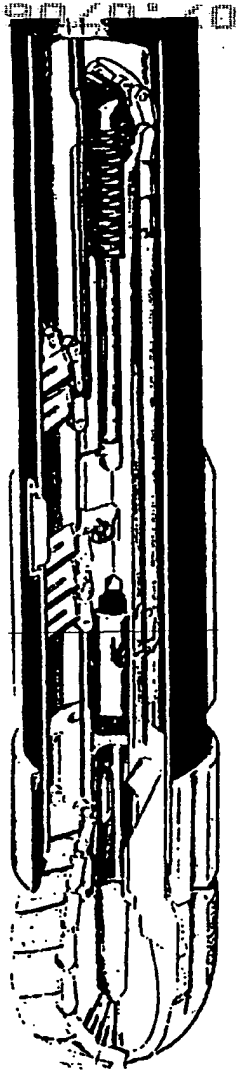

Fig. 4-5 Continuous-chain bit. (courtesy Oil & Gas Journal)

ting surfaces that can be changed without making a trip with the c string. In the prototype, the cutting structure consisted of both nat and man-made diamonds mounted in a hard matrix. Four poly line diamonds were used to cut the center of the hole, while ... diamonds were used to cut the rest of the hole. The cutting structure attached to links of a continuous chain that could be cycled downhol the pressure of the drilling fluid.

The continuous-chain bit advances the hole by using a combinatio bit weight and rotary speed as in conventional rotary drilling with ot bits. However, it is not yet in commercial oil and gas drilling serv

Other types of bits are also available for special drilling jobs. Corin a specialized, important part of the analysis of certain wells. I similar to conventional drilling in some ways, but the purpose of cor is to retrieve a large, undisturbed sample or core of the formation study.

A special family of coring bits has been developed. These have opening in the center. A core barrel is mounted above the tool to rec the core of formation cut by the bit. These bits are normally diam bits. The core cut by the coring apparatus is brought to the surface in core barrel and is analyzed to determine formation properties and type and amounts of any fluids in the formation.

General considerations

The drilling bit makes the hole, and anything that can be don speed the rate at which it removes rock lowers the cost of drilling.

In any well, there is a wide variety of formations to be drilled. So are very hard; some are relatively much softer. Some are abrasive; so are not. As bit development increased bearing life and cutting struct life, work was also done to design bits to drill a wider range of rock typ Now rotary rock bits are available with several cutting structu designed specifically for formations of all types.

Bits must be replaced when the cutting surface becomes so worn t penetration rate is slowed significantly or when bearings fail and the does not rotate properly. Ideally, bearings and cutting surface sho fail or wear out at about the same time.

How fast the rock is cut is not the only influence on drilling cos however. There is an optimum combination of rock-cutting speed a bit durability, or bit life. The search for this optimum is what has k bit designers busy for decades developing better bearing systems a better cutting structures.

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Pellet	Macerated	Macerated	Macerated	Chopped Cord	Macerated	Macerated	Pellets	Granular	Granular	Granular	Granular	Granular
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I-T-C	T-C	T-C	T-C	T-C	T-C	C	I-T-C	T-C	C	T-C	I-T-C	I-T-C
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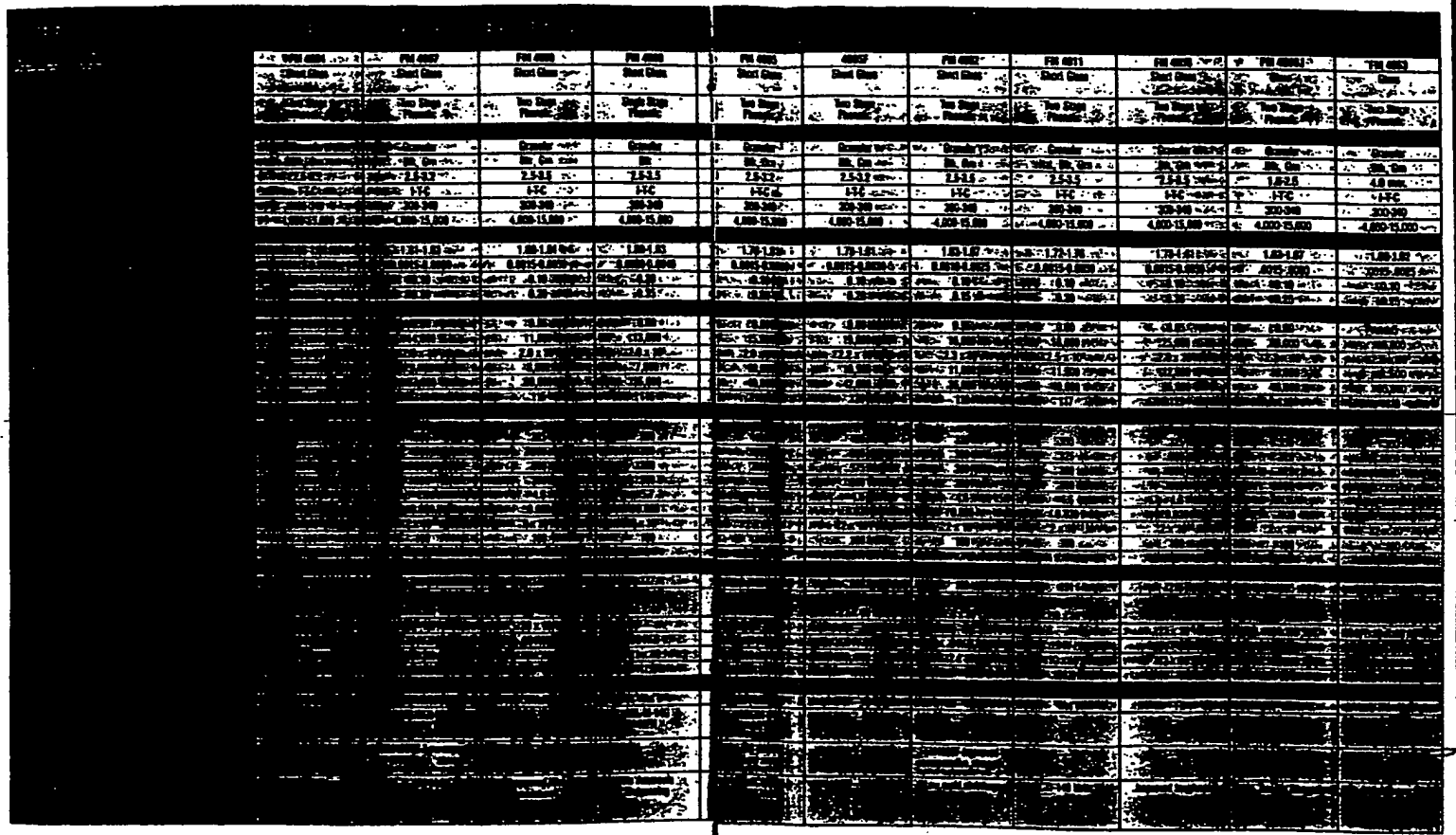

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- Injection Molding
- FDA/USDA Compliance

Fiberite specialty molding compounds allow designers to take the inherent advantages of thermoset materials to uncommon extremes—to heat, chemical and wear resistance, dimensional stability, conductivity, and other selected characteristics.

TYPE	Melamines				Polyester		
[illegible]	[illegible]	Electro-Mech. [illegible]	Electro-Mech. Short Glass	Electro-Mech. Long Glass	Electro-Mechanical Long Fiber		
[illegible]	M 2914	M 8204	M 2940	M 2927	8 000	8 705	8 7000
[illegible]	Cotton fabric [illegible]	Mineral	Glass	Glass	½" Chop Glass	½" Chop Glass	½" Chop Glass
[illegible]	Melamine	Melamine	Melamine	Melamine	Polyester	Polyester	Polyester
[illegible]	Granular	Putty	Granular	1" Chopped Fiber	BMC	BMC	BMC
[illegible]	Tan, Grn	Grn	Red	Tan, Brn	Bk, Brn, Gry	Bk, Brn, Gry	Bk, Brn, Gry
[illegible]	[illegible]	2.5-3.5	2.5-4.5	6.0-10.0	—	—	—
[illegible]	Compression	C-T	C-T-I	C-T	C-T	C-T	C-T
[illegible]	300-330	300-350	300-350	300-350	250-300	270-310	270-310
[illegible]	1,000-5,000	1,000-5,000	1,000-5,000	1,000-6,000	600-2,000	600-2,000	600-2,000
[illegible]	1.47-1.52	1.70-1.75	1.70-1.84	1.95-2.00	1.94-1.98	1.90-1.94	1.82-1.86
[illegible]	0.003-0.005	0.003-0.005	0.002-0.004	0.0004-0.0010	0.0010-0.0015	0.0004-0.0020	0.0004-0.0020
[illegible]	[illegible]	0.20	0.15	[illegible]	0.15	0.10	0.20
[illegible]	[illegible]	0.40	0.25	1.25	0.35	—	—
[illegible]	[illegible]	0.45	0.50	20.0	4.00	8.00	12.0
[illegible]	[illegible]	6,000	14,000	20,000	10,000	20,000	20,000
[illegible]	[illegible]	1.3 x 10^6	2.2 x 10^6	3.3 x 10^6	2.0 x 10^6	2.0 x 10^6	2.0 x 10^6
[illegible]	[illegible]	5,000	7,000	7,500	7,500	7,500	10,000
[illegible]	[illegible]	28,000	42,000	24,000	28,000	28,000	20,000
[illegible]	[illegible]	[illegible]	225	120	90	90	90
[illegible]	[illegible]	300	300	300	375	440	360
[illegible]	[illegible]	[illegible]	300	300	300	425	340
[illegible]	[illegible]	220	200	200	—	—	—
[illegible]	[illegible]	200	220	220	—	—	—
[illegible]	[illegible]	[illegible]	4.8	6.0	4.8	5.4	5.4
[illegible]	[illegible]	[illegible]	0.02	0.02	0.018	0.018	0.018
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.4 x 10^13	—	—
[illegible]	[illegible]	180	180	180	180	180	180
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	750	750	750
[illegible]	[illegible]	180	180	200	250	250	250
[illegible]	[illegible]	22 x 10^-6	20 x 10^-6	18 x 10^-6	—	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	15 x 10^-6	15 x 10^-6
[illegible]	[illegible]	[illegible]	94V-0	[illegible]	94V-0	94V-0	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—
[illegible]	[illegible]	[illegible]	Yes	—	Yes	Yes	—
[illegible]	[illegible]	MIL M 14G [illegible]	MIL M 14G [illegible]	[illegible]	—	—	MIL M 14G MAI-60
[illegible]	Special Colors Available	[illegible]	Special Colors Available	Chop lengths from ½"-1½"	—	—	—
[illegible]	[illegible]	Arc Track Resistance	Arc Track Resistance	Arc Track Resistance	—	—	—

TYPE	Vinyl Ester				Silicone	
[illegible]	Structural Long Fiber				Electro-Mechanical	
[illegible]	VE 5420	VE 5450	VE 40085	VE 50087	SI-6002	SI-6041
[illegible]	1" Chop Glass	1" Chop Glass	1" Chop Glass	1" Chop Carbon	Glass-Mineral	Long Glass
[illegible]	Vinyl Ester	Vinyl Ester	Vinyl Ester	Vinyl Ester	Silicone	Silicone
[illegible]	SMC	SMC	SMC	SMC	Granular	½" Glass Fibers
[illegible]	Bk, Grey	Bk, Grey	Nat, Bk, Grey	Bk	Bk, Red	Red
[illegible]	—	—	—	—	2.6-3.0	6.0-8.0
[illegible]	C	C	C	C	T-I	Compression
[illegible]	270-300	270-300	270-300	270-300	285-350	280-320
[illegible]	400-1,500	400-1,500	400-1,500	400-1,500	300-2,500	2,000-6,000
[illegible]	1.80-2.40	1.94-1.96	1.84-1.90	1.41-1.47	1.87-1.92	2.00-2.05
[illegible]	.0008	.0008	.0008	.0008	0.002-0.004	0.001-0.002
[illegible]	.15	.15	.15	.15	0.15	0.15
[illegible]	.30	.30	.30	.30	0.40	0.40
[illegible]	18.0	27.0	40.0	25.0	0.40	5.0
[illegible]	33,000	50,000	70,000	55,000	7,500	10,000
[illegible]	1.8 x 10^6	2.1 x 10^6	2.6 x 10^6	4.0 x 10^6	2.0 x 10^6	2.0 x 10^6
[illegible]	13,000	23,000	30,000	25,000	4,000	4,000
[illegible]	—	—	42,000	—	13,000	11,000
[illegible]	115	115	115	115	80	80
[illegible]	400	400	470	—	330	325
[illegible]	300	300	430	—	300	300
[illegible]	400	400	470	—	340	150
[illegible]	340	340	370	—	220	180
[illegible]	5.0	4.8	4.4	—	4.6	4.7
[illegible]	0.01	0.01	0.03	—	0.005	0.007
[illegible]	—	—	—	—	—	—
[illegible]	130	130	130	—	210+	180+
[illegible]	—	—	750	—	—	—
[illegible]	220	220	220	220	280+	280
[illegible]	—	—	—	—	[illegible]	[illegible]
[illegible]	8 x 10^-6	13 x 10^-6	10 x 10^-6	3 x 10^-6	33 x 10^-6	7.0 x 10^-6
[illegible]	—	—	—	—	94V-0	94V-0
[illegible]	—	—	—	—	5.5 x 10^-4	5.5 x 10^-4
[illegible]	—	—	—	—	—	—
[illegible]	Yes				—	—
[illegible]	—	—	—	—	MIL M14G MSI-30	MIL M14G MSI-30
[illegible]	FR Grade Available	FR Grade Available	FR Grade Available	—	—	Transfer Grade-SI-6040
[illegible]	½", 2" Chops Available	½", 2" Chops Available	½", 2" Chops Available	½", 2" Chops Available	300°F Use Temperature	600°F Use Temperature

TYPE	Polyimide				
[illegible]	High Temperature Resistance				
[illegible]	PI-720	PI-740	PI-745	PI-750	PI-40263
[illegible]	Glass-Mineral	Short Glass	Med. Glass	Long Glass	Graphite
[illegible]	Polyimide	Polyimide	Polyimide	Polyimide	Polyimide
[illegible]	Granular	½" Glass Fibers	½" Glass Fibers	½" Glass Fibers	1" Chop
[illegible]	Bk, Nat	Bk, Nat	Bk, Nat	Bk, Nat	Bk
[illegible]	2.0-3.0	6.0-10.0	6.0-10.0	6.0-10.0	6-10
[illegible]	T-I	C-T	Compression	Compression	Compression
[illegible]	350-420	400-480	400-480	400-480	400-480
[illegible]	500-2,500	1,000-6,000	1,000-5,000	1,000-5,000	2,000-4,000
[illegible]	1.85-1.90	1.90-1.95	1.80-1.95	1.85-2.00	1.45-1.50
[illegible]	0.001-0.002	0.001-0.002	0.001-0.002	0.0005-0.001	0.001-0.002
[illegible]	0.10	0.30	0.30	0.30	—
[illegible]	0.30	0.50	0.50	0.50	—
[illegible]	0.40	7.0	20.0	22.0	20.0
[illegible]	20,000	26,000	26,000	37,000	40,000
[illegible]	2.0 x 10^6	2.8 x 10^6	2.6 x 10^6	3.1 x 10^6	7.0 x 10^6
[illegible]	14,000	15,000	21,000	21,000	16,000
[illegible]	35,000	34,000	34,000	32,000	20,000
[illegible]	110	110	110	110	80
[illegible]	400	400	400	400	NA
[illegible]	350	300	300	300	NA
[illegible]	—	—	—	—	NA
[illegible]	—	—	—	—	NA
[illegible]	4.85	4.8	4.8	4.8	NA
[illegible]	0.003	0.003	0.004	0.004	NA
[illegible]	—	2.5 x 10^16	2.5 x 10^16	2.5 x 10^16	NA
[illegible]	180	125	125	125	NA
[illegible]	—	—	—	—	NA
[illegible]	280	300	280	280	250
[illegible]	[illegible]	[illegible]	—	—	[illegible]
[illegible]	28 x 10^-6	15 x 10^-6	13 x 10^-6	10 x 10^-6	13 x 10^-6
[illegible]	—	—	—	—	[illegible]
[illegible]	3.1 x 10^-4	8.0 x 10^-4	9.8 x 10^-4	9.8 x 10^-4	34 x 10^-4
[illegible]	—	—	—	—	NA
[illegible]	—	—	—	—	[illegible]
[illegible]	—	—	—	—	NA
[illegible]	—	Screw Plasticator Grade Available	—	—	¼", ½", 2" [illegible]
[illegible]	—	500°F Use Temperature	550°F Use Temperature	500°F Use Temperature	Compression Moldable

MOLDING COMPOUNDS APPLICATIONS

Here are some of the many ways Fiberite molding compounds are in use today—in electronics, transportation, electrical, materials handling and defense/ordnance applications. Each application represents a highly considered choice by designers, materials analysts, and process engineers against the criteria of cost-performance. For more information on any application listed here – or on many others that are not – just give Fiberite a call. We can custom formulate to your design requirements.

Electronics

APPLICATION	COMPOUND	FEATURES	BENEFITS	PROCESSING
COMPUTERS				
Connectors	FM4004 FM4005 FM4005F FM4007	Dimensional stability Low shrinkage Heat resistance Electrical resistance	Tight tolerance fabrication without secondary operation No creep [illegible]	Injection Transfer
Stiffener Frames	[illegible]	Dimensional [illegible] Low shrinkage [illegible] Heat resistance [illegible]	Tight tolerance fabrication without secondary operation Allows automated assembly Reduces cost [illegible]	Compression
Bearings	FM3000	[illegible] Wear resistance [illegible]	Lightweight [illegible] Moldable to shape without secondary operation	Injection Transfer
Print Disks	FM4011 [illegible]	Hard surface [illegible] Dimensional [illegible] Paintable [illegible]	Lightweight [illegible] Durable [illegible]	Injection Transfer
Strain Relief	FM4007 [illegible]	Dimensional [illegible] Heat resistance [illegible]	Tight tolerance fabrication [illegible] No creep [illegible]	Transfer
Idler Pulleys	FM400[illegible]	[illegible] Dimensional [illegible]	Better performance and [illegible] lower cost than metal	Injection Transfer
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ink Jet Printers [illegible]	[illegible]	[illegible]	Tight tolerance [illegible] without secondary operation	Injection Transfer

The improved dimensional stability of our molding compounds, plus superior thermal and chemical resistances extends product longevity and reduces failure rates.

APPLICATION	COMPOUND	FEATURES	BENEFITS	PROCESSING
BUSINESS MACHINES (CONTINUED)				
Fiber Optics	FM4005	Low shrinkage Dimensional stability Low melt viscosity	Tight tolerance fabrication without destruction of fiber optics media	Transfer
Copier Fuser Rod Endcaps	PI730 PI740 PI750	High strength Excellent chemical resistance High temperature resistance	Extended part life Corrosion resistance	Compression
AEROSPACE/AIRCRAFT				
Connectors	FM4005D	Dimensional stability Heat resistance Improved electrical resistance	Tight tolerance fabrication No creep Allows high density connectors	Injection Transfer
	E83543	Chemical resistance Heat resistance Dimensional stability Corrosion resistance	Non-outgassing Withstands VP soldering Provides excellent "true" position required in high density high performance connections	Injection Transfer
Switches	FM22436 FM21386	Sliding wear resistance	Improved switch longevity	Transfer
Missile Control Housings	PI750	Temperature resistance Excellent mechanical properties	Maintains high strength at elevated temperatures	Compression
Fuselage Antennas	E8364	Dimensional stability Temperature resistance	Withstands high mechanical stresses at temperature extremes experienced on exterior of jet aircraft	Transfer
[illegible]				
[illegible]	E2748J	Dimensional stability at elevated temperatures Excellent thermal properties Excellent thermal shock resistance	Withstands rapid heat-up under hood of car Maintains excellent electrical properties at high operating temperatures and vibration Ease of fabrication	[illegible]
[illegible]	[illegible]	Soft flow Gold color [illegible]	Ease of fabrication Laser markability	[illegible]
[illegible]	[illegible]	Excellent electrical properties Moisture resistance Gold color Thermal cycle performance	[illegible] Laser markability	[illegible]
[illegible]	[illegible]	[illegible] Thermal shock resistance Gold color Moisture resistance	Components pass all military specifications including thermal cycle and moisture resistance High reliability [illegible] Laser markability	[illegible]
[illegible]	[illegible]	Dimensional stability Low shrinkage Heat resistance Electrical resistance	Tight tolerance fabrication without secondary operation No creep [illegible]	[illegible]
[illegible]	[illegible]	Low pressure molding Good electrical properties Soft flow [illegible]	Withstands extreme vibration of motor control systems Ease of fabrication Thermal shock resistance	[illegible]
[illegible]	[illegible]	High thermal conductivity General purpose properties	Heat dissipation Cost performance	[illegible]
[illegible]	[illegible]	Excellent mechanical properties Low thermal expansion	Thermal shock resistance	[illegible]
[illegible]	[illegible]	Low viscosity [illegible] Lower temperature molding [illegible] Fast cure [illegible]	Low pressure molding of sensitive components Short cycles	[illegible]

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MOLDING COMPOUNDS APPLICATIONS

Easy processability, tight tolerances and reduced machining make Fiberite materials the choice for mass-produced transportation applications.

Transportation (Autos, Buses, Trucks)

APPLICATION	COMPOUND	FEATURES	BENEFITS	PROCESSING
[illegible]				
Cruise Control Valves	FM4004	Dimensional stability Heat resistance	Tight tolerance fabrication without secondary operation Lower cost than metal	Injection
Timing Gears	FM32168	Dimensional stability Heat resistance Motor oil resistance	Lower cost than metal Noise dampening Tight tolerance fabrication	Compression
[illegible]				
Turbine Spacers	FM4004S	Dimensional stability Low shrinkage Heat resistance	Tight tolerance fabrication No creep Lower cost than metal	Injection
Stators	FM4063	Dimensional stability Heat resistance Impact strength	Tight tolerance fabrication Lower cost than metal No creep	Transfer
Accumulator Pistons	FM4004S	Dimensional stability Heat resistance Low shrinkage	Tight tolerance fabrication No creep Lower cost than metal	Injection
[illegible]				
Front Disc Brake Caliper Pistons	FM4029	High compressive strength Heat resistance Low thermal conductivity Low thermal expansion Dimensional stability	Compatible with functions and temperatures of brake operation Provides thermal insulation between rotor and brake fluid Lower cost than metal	Compression
Power Steering Bushings	FM3001	Dimensional stability Low coefficient of friction Wear resistance	Superior performance than metal in extreme temperatures Lower cost than metal	Injection Compression
[illegible]				
Water Pump Housings	FM4002	Low water absorption Dimensional stability	Tight tolerance fabrication Corrosion resistance Lower cost than aluminum	Transfer

Electrical Transmission and Distribution

APPLICATION	COMPOUND	FEATURES	BENEFITS	PROCESSING
[illegible]	FM1132[illegible] FM6544	[illegible]	[illegible]	Compression Transfer
Electrical Switchgear [illegible]	[illegible]	[illegible]	[illegible]	Compression Transfer
[illegible]	[illegible]	[illegible]	[illegible]	Injection
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Welding [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Welding [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

APPLICATION	COMPOUND	FEATURES	BENEFITS	PROCESSING
[illegible]				
Pad Mount Transformers	E8354	Dimensional stability Excellent electrical properties Mechanical properties	Provides electrical insulating capability without corona problems Withstands extreme operating temperature changes Molds very reproducibly	Transfer
	E8630	General purpose properties Intermediate mechanical properties Excellent electrical properties Lower cost	Cost performance advantage Dimensional stability in transformer oil	Transfer
[illegible]				
8.3 - 35kV Bushings	E8353	Excellent electrical performance Controlled rheology	Provides electrical insulating capability without corona problems Withstands extreme operating temperature changes Molds very reproducibly	Transfer
Low Voltage Bushings	E8630	Intermediate mechanical properties Excellent electrical properties Lower cost	Cost performance advantage Dimensional stability in transformer oil	Transfer

Specialty

APPLICATION	COMPOUND	FEATURES	BENEFITS	PROCESSING
Printer Carriage Bearings	FM4009	Dimensional stability Wear resistance	Tight tolerance fabrication Lower cost than metal	Injection
Power Steering Bushings	FM3001	Dimensional stability Low coefficient of friction Wear resistance	Superior performance than metal in extreme temperatures Lower cost than metal	Compression Injection
Journal Bearings	FM3000 FM3001 FM3002	Dimensional stability Low coefficient of friction Wear resistance	Tight tolerance fabrication Lower cost than metal	Compression Injection Transfer
[illegible]				
Fracture Ball Cores	FM4555	Controlled specific gravity Rubber overmold compatibility	Exact weight balls Lower cost than metal	Compression
Fracture Ball Cores	E5324	Low pressure molding Low specific gravity	Ease of fabrication Controlled gravity components for field control Lower cost	Compression
[illegible]				
Fracture Ball Cores	FM8729	Controlled specific gravity Rubber overmold compatibility	Exact weight balls Lower cost than metal	Compression
Practice Ammunition	FM8729	High specific gravity Controlled properties	Simulates metal round Frangibility Lower cost than metal	Transfer
[illegible]				
High Temperature Connectors	SI3082	Heat resistance Dimensional stability at elevated temperatures	Operates in high temperature autoclave Maintains insulation qualities	Injection
Glass Handling Components	SI3045	Heat resistance Low thermal conductivity Lubricity	Handles bottle temperature of 700°F Energy efficient Low friction surface	Compression Transfer
Welding Gun Heads	SI3041	Heat resistance Impact strength	Meets end-use handling High temperature performance	Compression
Jet Engine Heat Deflectors	PI745	Heat resistance High physical properties	Withstands high temperature operating environments	Compression

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Preform Service

The broad range of Fiberite preform service complements our unique mix of molding compounds. Our preform capability handles virtually all products — from free flowing granular compounds to high bulk factor fabric and glass fiber reinforced compounds.

Fiberite offers three categories of preform sizes, classified by physical form and reinforcement:

8820 057 nylon

Fabric Filled Materials

Diameter (Inches)	(MM)	Minimum Grams	Maximum Grams
1 11/16	42.9	20	100
2 1/16	52.3	30	200
2 1/8	55	40	200
2 3/8	60.5	40	210
2 1/2	63.5	65	250
2 3/4	69.9	50	290
3 1/2	88.9	100	400
4	101.6	160	475
4 1/2	114.3	190	555
1 1/4 x 4 (rectangular)		70	175
3 x 4 (rectangular)		100	325

Preform weight tolerances
20 to 100 Grams - plus or minus 2 Grams
101 to 200 Grams - plus or minus 3 Grams
201 to 555 Grams - plus or minus 4 Grams

Glass Fiber Reinforced Materials

Diameter (Inches)	(MM)	Minimum Grams	Maximum Grams
2 1/8	55	40	200
2 1/2	63.5	65	250
3	76.2	85	390
1 1/4 x 4 (rectangular)		70	175
3 x 4 (rectangular)		100	325

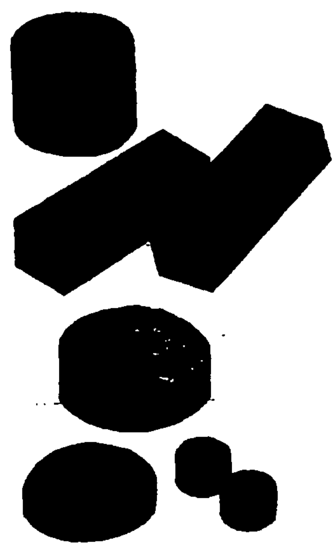
Preform weight tolerances
40 to 200 Grams - plus or minus 3 Grams
201 to 450 Grams - plus or minus 4 Grams

Granular Materials

Diameter (Inches)	(MM)	Minimum Grams	Maximum Grams
3/4	19.1	3	12
1	25.4	4	25
1 1/4	31.8	10	32
1 1/2	38.1	12	60
1 1/2	38.1	15	75

Preform weight tolerances
3.0 to 14.0 Grams - plus or minus 1/2 Gram
15.0 to 40.0 Grams - plus or minus 1 Gram
41.0 to 80.0 Grams - plus or minus 1 1/2 Grams

The above weights and tolerances are standard, however; dependent upon product type and bulk factor, non-standard weights and tolerances may also be available.



Dear Customer:
Let us know how Fiberite can be of service to you. Please fill out the applicable information below, fold and mail.

Request for quote

The following Fiberite compound appears to meet my needs. Please give me an estimate on cost.

Fiberite compound # ______
Program/application ______

Current program status ☐ concept ☐ design ☐ prototype ☐ production
Volume requirements ______ month
______ year

Request for detailed specifications

As yet, I've been unable to match a Fiberite compound with my specific application. Please make a recommendation, based on the following performance requirements:

	Material #1	Material #2
REINFORCEMENT	______	______
RESIN SYSTEM	______	______
PROCESSING CONDITIONS	______	______
Form	______	______
Color	______	______
Bulk Factor	______	______
Molding Methods	______	______
Molding Temperature, °F	______	______
Molding Pressure, psi	______	______
PHYSICAL PROPERTIES		
Specific Gravity	______	______
Mold Shrinkage, in/in.	______	______
Water Absorption (%, 24 hrs. 23°C)	______%	______%
(%, 48 hrs. 50°C)	______%	______%
MECHANICAL		
Impact Strength, ft. lbs./in. notch, side	______	______
Flexural Strength, psi	______	______
Flexural Modulus, psi	______	______
Tensile Strength, psi	______	______
Compressive Strength, psi	______	______
Hardness, Rockwell M	______	______

(Continued next column)

	Material #1	Material #2
ELECTRICAL		
Dielectric Strength, volts/mil, (1/8-in. thickness) ST Dry	______	______
SS Dry	______	______
ST Wet	______	______
SS Wet	______	______
Dielectric Constant, 1 MHz	______	______
Dissipation Factor, 1 MHz	______	______
Volume Resistivity, ohm-cm	______	______
Arc Resistance, Sec.	______	______
THERMAL		
Deflection Temp @ 264 psi, °C	______	______
Thermal Expansion, in./in./°C		
-30°C to +30°C	______	______
-23°C to +150°C	______	______
Flammability Rating	______	______
Thermal Conductivity, Cal/Sec/Cm²/°C/Cm	______	______
Oxygen Index	______	______
SPECIAL FEATURES		
UL Listing	______	______
Mil. Specification	______	______
Other Features	______	______

Request for applications information or service

☐ Please send me ______ additional copies of Fiberite's Molding Compounds Selection Handbook.

☐ Have a sales engineer call me.
Phone (___) ______

Name ______
Title ______
Company ______
Address ______
City, State, Zip ______

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MOLDING COMPOUNDS APPLICATIONS

Fiberite molding compounds survive the toughest conditions, delivering reliable thermal performance in temperatures as high as 300°C.

Materials Handling and Processing

Application	Compound	Features	Benefits	Processing
[illegible]				
Industrial Water Softener Valve Bodies	FM4024	Dimensional stability Low shrinkage FDA compliance	Tight tolerance fabrication without secondary operation Lower cost than metal	Transfer
Chemical Pump Valve Body & Impellers	E7111	[illegible] Chemical resistance Dimensional stability	No corrosion Lower cost Fabrication with minimum secondary operation	Compression
Pump Rotors & Housings	E2748-8541CB	Impact resistance Chemical resistance Thermal stability Corrosion resistance	Excellent service in variety of liquids at elevated temperatures Cost performance	Compression
PETROCHEMICAL				
Butterfly Valve Backing Rings	FM3518 E7459 S666	Dimensional stability Lightweight [illegible] Rubber [illegible] compatibility	[illegible] Lower cost than metal	Compression
Fracture Balls	FM6720 FM[illegible]	Controlled specific gravity Rubber [illegible] compatibility	[illegible] weight balls [illegible] cost than metal	Compression
Valve Assemblies	[illegible] E74[illegible]	[illegible] Dimensional stability Chemical resistance Heat resistance	Tight tolerance fabrication without secondary operation [illegible]	[illegible] Transfer
Pump Rotors & Housings	[illegible] E2748	Chemical resistance Impact resistance Elevated temperature service [illegible]	Excellent service for [illegible]	[illegible] Compression Transfer
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pump Rotors & Housings	E2748-[illegible]	[illegible]	[illegible]	[illegible]
Pump Rotors & Housings	E2748-8541[illegible]	[illegible]	[illegible]	[illegible]
Pump Rotors, Pump Housings & Screens Bodies	E2748-[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	E2748-[illegible]	[illegible]	[illegible]	[illegible]
Pump Rotors & Housings	E2748-[illegible]	[illegible]	[illegible]	[illegible]
Pump Rotors, Pump Housings & Screen Bodies	E2748-8541C[illegible]	[illegible]	[illegible]	[illegible]

Application	Compound	Features	Benefits	Processing
Sprayer Tips	FM3303 [illegible] [illegible] FM3800	Wear resistance Chemical resistance	Durability and component longevity No corrosion [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Spinning Nozzles	FM4111	Dimensional stability Chemical resistance	Fabrication to tolerance [illegible] without secondary operation Corrosion resistance [illegible] Low cost	[illegible]

Defense/Ordnance

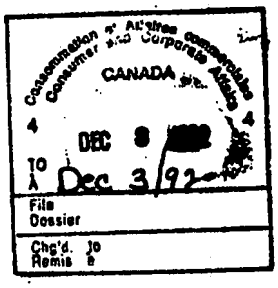
Handguards	FM8130E FM8130	High strength Heat resistance Low thermal conductivity	Resistance to high barrel temperatures and breakage during use	Compression
Butt Stocks	FM8130	Impact resistance	Resistance to breakage during use	Transfer
Pistol Grips	FM7700	Impact resistance	Resistance to breakage during use	Transfer
Rotor Tips	FM3294	High strength Low specific gravity	Lower cost than metal Lighter than metal	Compression
Practice Rounds	FM6720	High specific gravity Controlled properties	Simulates metal round Frangibility Lower cost than metal	Transfer
Missile Control Housing	FI750	High strength High temperature resistance	Withstands short term temperature exposure in excess of 500°F Withstands the physical abuse of actual performance	Compression
Trays, Cups & Plates	M2814	High strength Available in colors Hard surface	Scratch resistance Stain resistance Low breakage loss	Compression
Rocket Nozzles	FM4005 FM16771 FM4030190 FM8130	Dimensional stability High strength Ablative qualities	Prevents burn-through during firing Lower cost procedure than lay-up	Compression Transfer
Actuator Valve Bodies	FM4005	Dimensional stability High tensile strength Low shrinkage	Tight tolerance fabrication without secondary operation Lighter weight than metal Lower cost than metal	Injection
Insulators	FM8130	High strength Low thermal conductivity	Heat insulation after ignition of rocket propellant	Compression
Conduit Covers	FM16771	Heat resistance	Missile component thermal protection	Compression
Aluminum Chaff Dispensers	FM4005M	High hoop strength Dimensional stability Lightweight	Tight tolerance fabrication Resists pneumatic pressure failures Lower cost than metal	Compression

Dtk2.

E21B -034/12

File No. 5059-598 RM/EC

Montreal, Canada
December 3, 1992



In re Application of

STEVEN G. STREICH ET AL

Serial No. 2,071,721-1

Filed June 19, 1992

For: DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF

- - - - - - - - - - - - - - - -

VOID!
A601 2126333 3797 8:37AM 12/09/92

The Commissioner of Patents,
Ottawa-Hull, Canada.
K1A 0C9

Sir:

This letter constitutes a voluntary amendment in which we would ask the Office to cancel the formal drawings presently on file and to substitute therefor the new set of formal drawings enclosed herewith.

The new set of formal drawings is being submitted as it is much clearer than the set on file.

At the same time, enclosed herewith, in duplicate, is an Assignment from the inventors to HALLIBURTON COMPANY, which we would ask the Office to register against the above-identified application.

Also enclosed is a cheque in the amount of $100.00 to cover the Government recording fee.

FOREIGN - 20 FEB 2006

K301 100.00
16667 6
A601 2126333 3797 8:37AM 12/09/92

The Commissioner of Patents

We look forward to receiving the recorded copy of the Assignment in due course.

Respectfully,

STEVEN G. STREICH ET AL

By: Swabey Ogilvy Renault

Patent Agents of the Applicant

Encs. - formal drawings
Assignment in duplicate
cheque $100.00

#0990 20 OCT 2000

2071721

2071721 · 07/20/2006

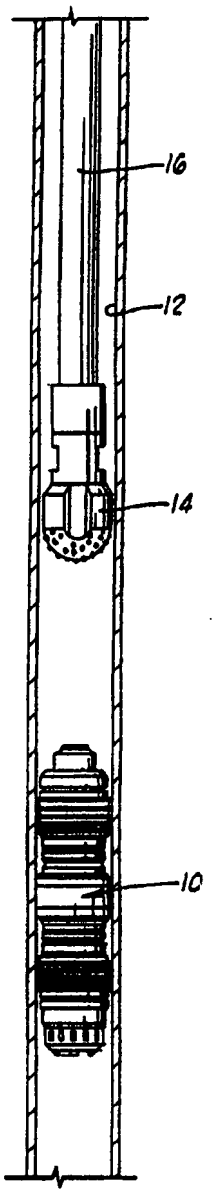


FIG. 1

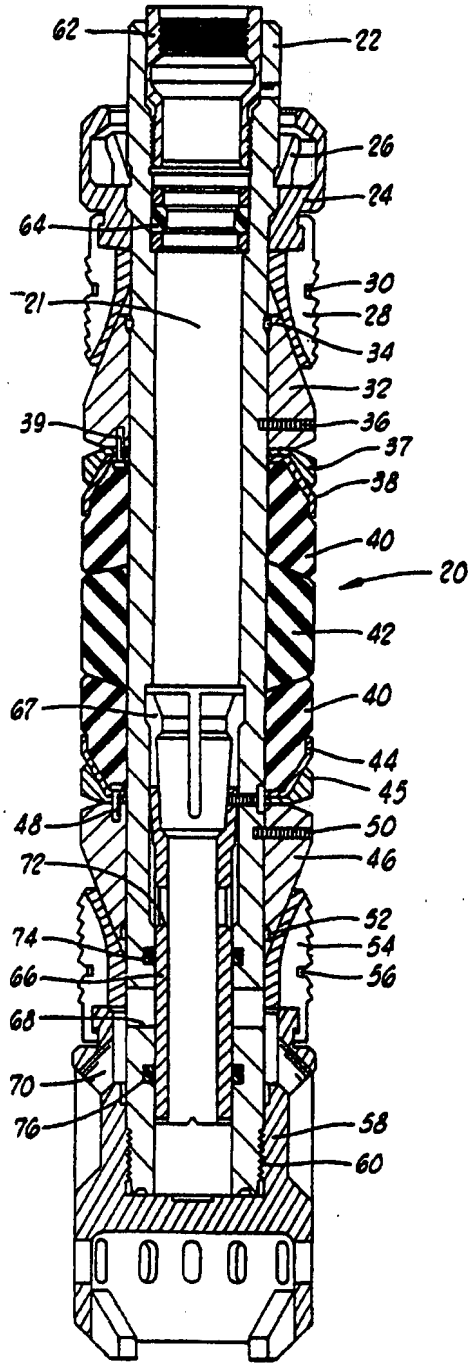


FIG. 2

CANCELLED

PATENT AGENTS

Swabey Ogilvy Renault

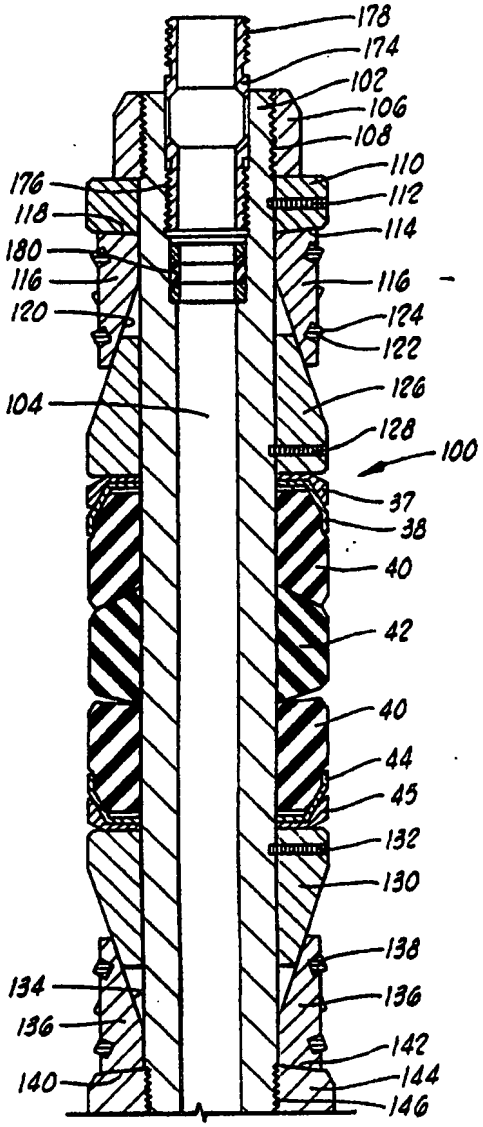


FIG. 3A

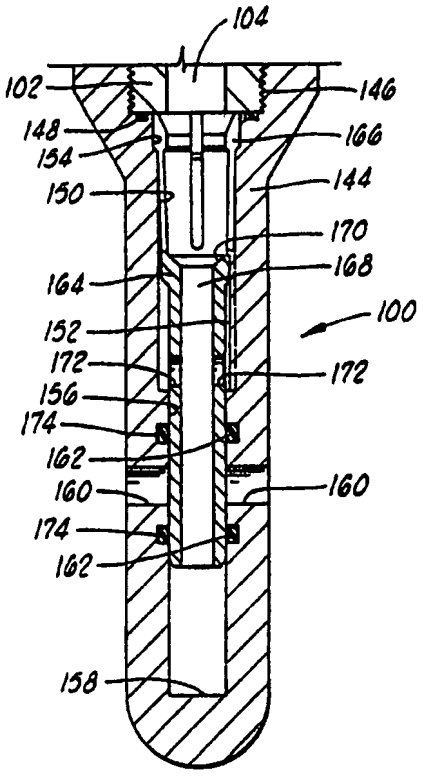


FIG. 3B

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CANCELLED

PATENT AGENTS.

Dwabey Ogilvy Renault

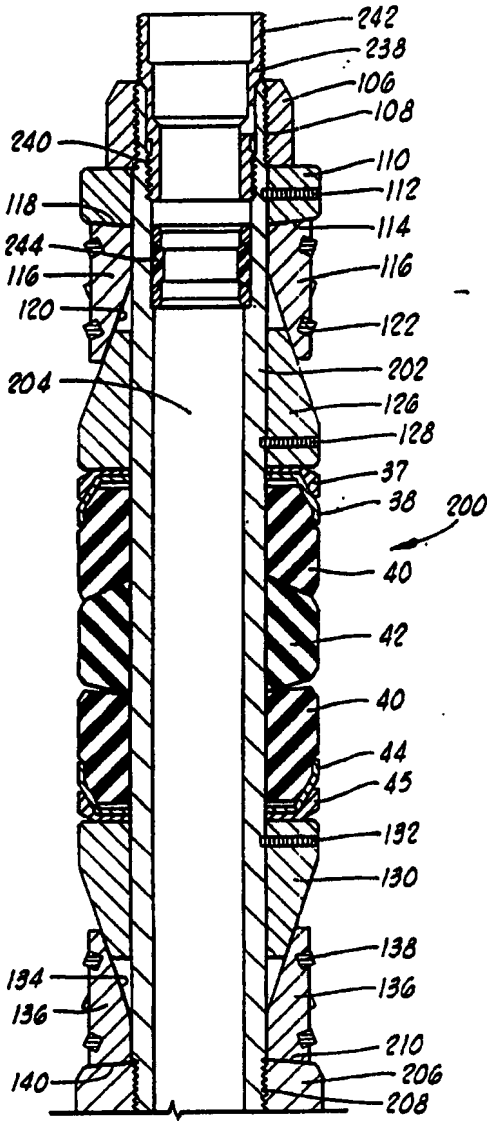


FIG. 4A

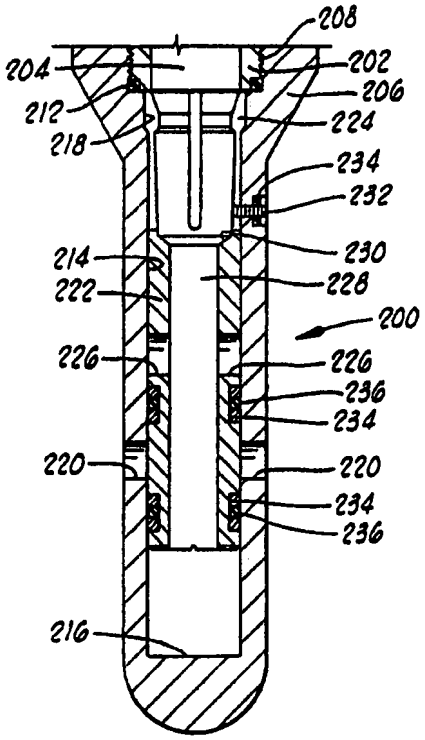


FIG. 4B

4090720 - 20FZ00006

CANADA
PATENT AGENTS
Swabey Ogilvy Renault

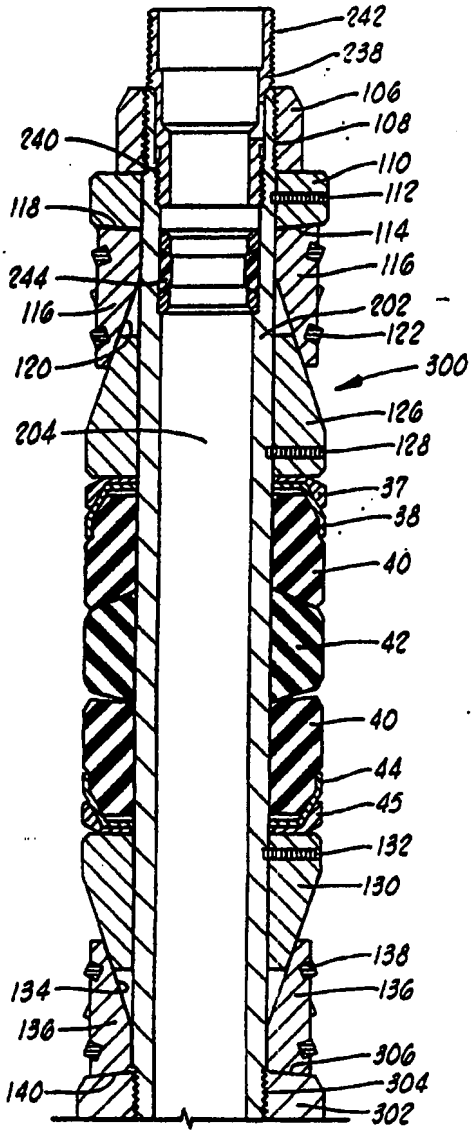


FIG. 5A

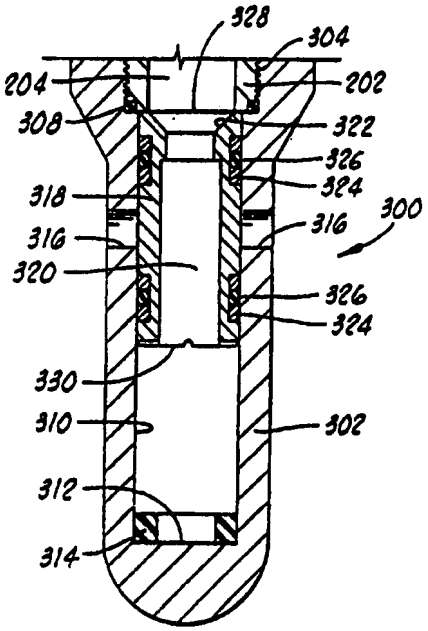


FIG. 5B

4,590,720 - 27 05 2006

AMENDED

PATENT AGENTS

Dwakey Ogilvy Renault

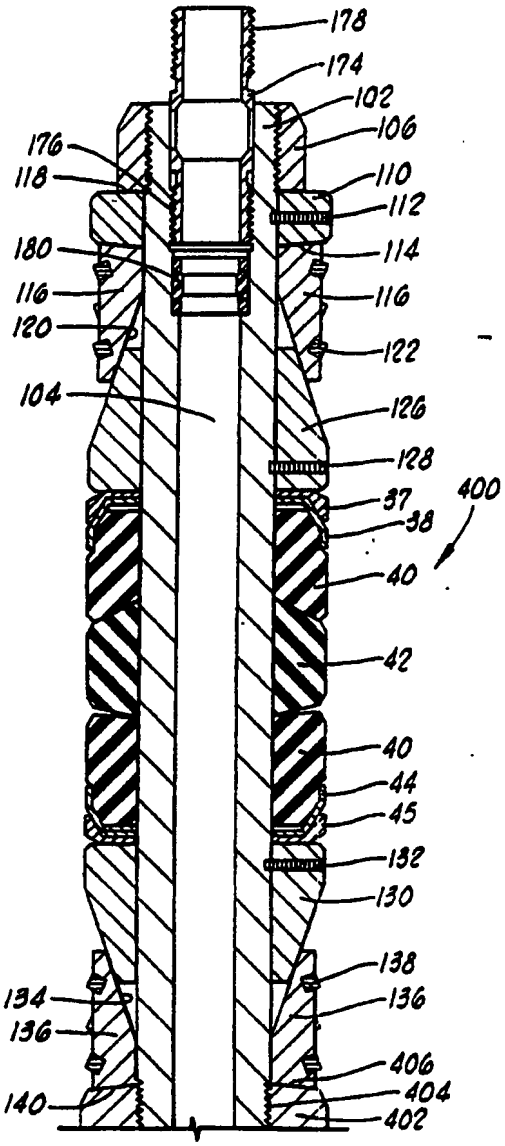


FIG. 6A

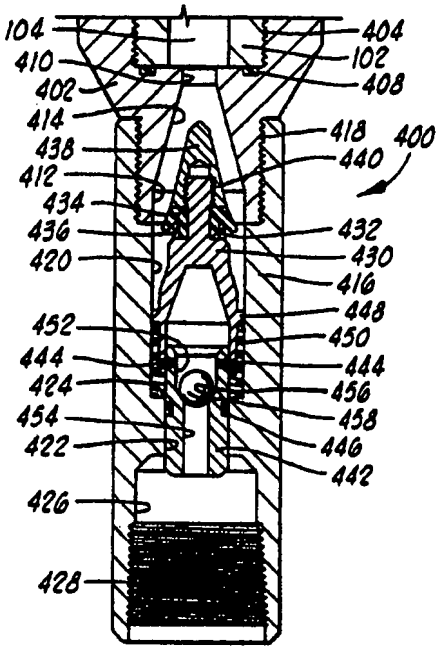


FIG. 6B

CANCELLED
ANNULÉE

PATENT AGENTS
Swabey Ogilvy Renault

tb90270 20T20005

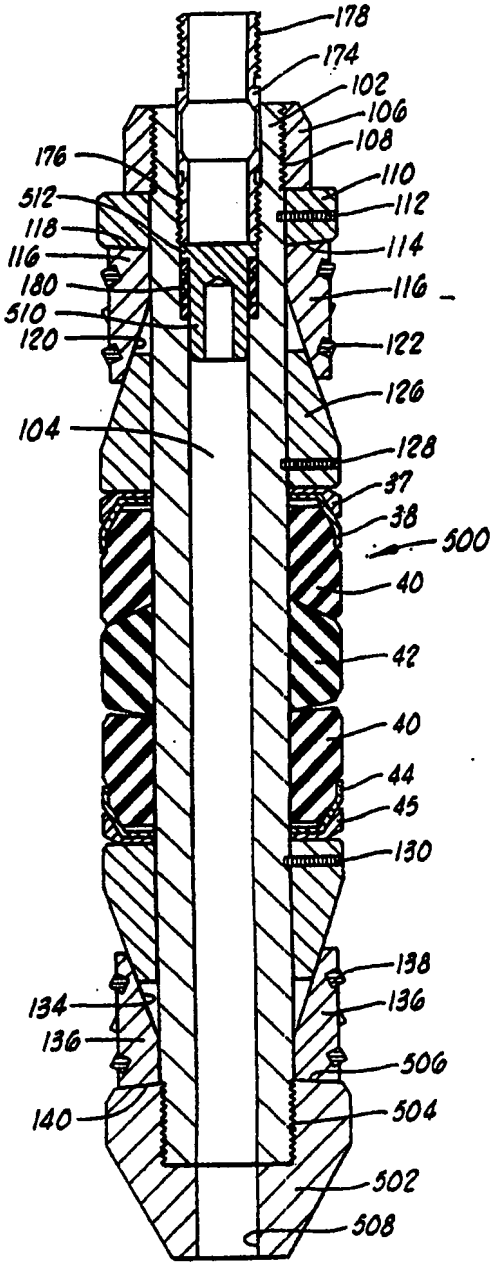


FIG. 7

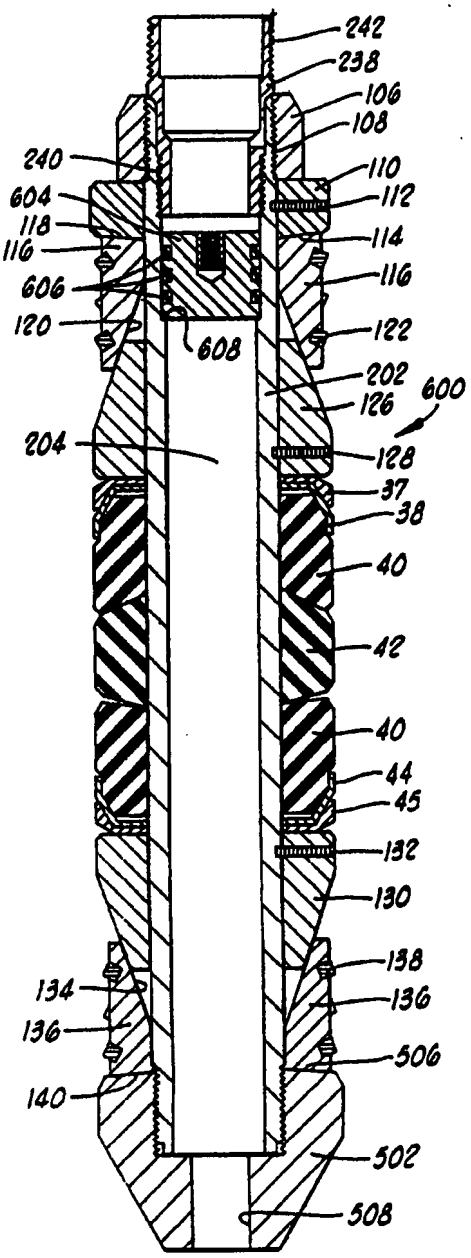


FIG. 8

CANCELLED

PATENT AGENTS

Swabey Ogilvy Renault

[redacted]

SWABEY OGILVY RENAULT

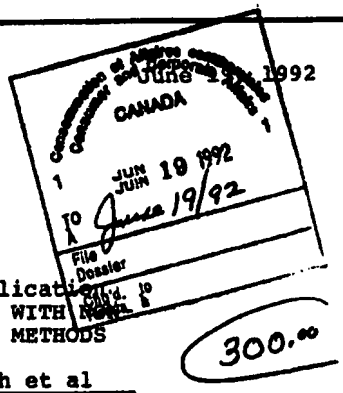
INCORPORATING THE PRACTICE OF SWABEY, MITCHELL, HOULE, MARCOUX & SHER

PATENT AND TRADE MARK AGENTS

YOUR REF.:

PLEASE QUOTE: 5059-598 PM/RM/Bs

June 19, 1992



Commissioner of Patents,
Place Du Portage
Hull, Quebec
CANADA K1A 0C9

New Canadian Patent Application
DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF
Invs.: Steven G. Streich et al

300.00

Sir:

Enclosed are the papers for the filing of a new patent application, for which your petitioner(s) pray(s) that a patent may be granted.

- [X] Petition with Appointments of Agent and Representative
- [ ] Acceptance of nomination of representative
- [ ] Appointment of Associate Agent
- [ ] Assignment in duplicate in favour of:
- [X] Disclosure
- [X] Abstract in duplicate
- [X] Claims in duplicate
- [X] Drawings: Formal [X] Informal [ ]
- [ ] Request for Examination
- [ ] Government Fees - Filing [ ]
  Assignment [ ]
  Examination [ ]
- [X] Priority claimed on Application(s) S.N. 719,740
  Filed June 21, 1991
  Country U.S.A.

K301 300.00
13930 $
A212 2126111 2491 6:21PM 6/25/92

The Official Filing Receipt is anticipated in due course.

Respectfully,
SWABEY OGILVY RENAULT

Enc. Cheque No. 13930

MONTREAL

1981 DE MAISONNEUVE BLVD. WEST, SUITE 800
MONTRÉAL, QUÉBEC, CANADA H3A 3C8
CABLE SWAPAT-MTL TELEX 05-24339
FAX (514) 288-8389
TELEPHONE (514) 849-7126

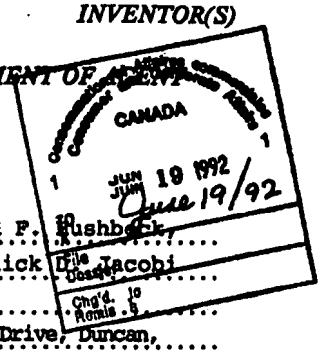
OTTAWA

NO. 508/80

CANADA

INVENTOR(S)

PETITION BY INVENTOR(S) AND APPOINTMENT OF AGENT



To the Commissioner of Patents,
Ottawa-Hull, K1A 0E1 Canada.

all US

The Petition of Steven G. Streich, Donald F. Mushbach, Kevin T. Berscheidt and Rick D. Jacobi

whose full post office address(es) is (are) 1605 Terrace Drive, Duncan, Oklahoma 73533, U.S.A.; 2609 Leigh, Duncan, Oklahoma 73533, U.S.A.; 730 Drexal, Duncan, Oklahoma 73533, U.S.A.; and 714 Carriage Drive, Duncan, Oklahoma 73533, U.S.A.; respectively

Sheweth: —

1. THAT Your Petitioner(s) made the invention entitled DOWNHOLE TOOL APPARATUS WITH NON-METALLIC COMPONENTS AND METHODS OF DRILLING THEREOF

which is described and claimed in the specification submitted herewith.

2. THAT Your Petitioner(s) verily believe(s) that he (they) is (are) entitled to a patent for the said invention having regard to the provisions of the Patent Act.

3. YOUR Petitioner(s) request(s) that this application be treated as entitled to the rights accorded by section 29 of the said Act having regard to the application(s) of which particulars are set out below, and represent(s) that the said application(s) is (are) the first application(s) for patent for the said invention filed in any country which by treaty, convention or law affords similar rights to citizens of Canada by the Inventor(s) or anyone claiming under him (them).

Give particulars here ONLY of the application or applications upon which the claim for priority is based.

U.S.A. / No. 719,740 / June 21, 1991

US 91-06-21

4. THAT Your Petitioner(s) hereby nominate(s) SWABEY OGILVY RENAULT who resides or carries on business in Canada at the following address: 1001, boulevard de Maisonneuve Ouest, Montréal, Québec, Canada H3A 3C8, to be his(their) representative for the service of any proceedings taken under the Act.

5. THAT Your Petitioner(s) hereby appoint(s) SWABEY OGILVY RENAULT, whose full post office address is 1001, boulevard de Maisonneuve Ouest, Montréal, Québec, Canada H3A 3C8 as his(their) agents, with full power to appoint an associate agent when required to do so by section 144 of the Patent Rules and to revoke such appointment, to sign the petition and drawings; to amend the specification and drawings, to prosecute the application and to receive the patent granted on the said application; and ratify(ies) any act done by the said appointee in respect of the said application.

6. YOUR Petitioner(s) therefore pray(s) that a patent may be granted to him (them) for the said invention.

Signed at Montreal, Quebec, Canada

this 19 *day of* June *19*92

Steven G. Streich et al

By: Swabey Ogilvy Renault
Inventor(s) or Patent Agent(s)

Patent Agents of the Applicant

FORM 503/89
PRINTED IN CANADA

DO NOT SCALE

CANADA

Assignment of Invention

2071781
HSD 89.116B1 (JRD)
(Canada)

I/We Steven G. Streich, Donald F. Hushbeck, Kevin T. Berscheidt, and Rick D. Jacobi
(Name of Assignor/s)

whose full post office address is 1605 Terrace Drive, Duncan, Oklahoma 735331
2609 Leigh, Duncan, Oklahoma 73533; 730 Deseal, Duncan, Oklahoma 73533; and
714 Carriage Drive, Duncan, Oklahoma 73533; respectively,

, in consideration of One Dollar the receipt of which is hereby acknowledged, have and by these presents, do hereby sell and assign to

Halliburton Company
(full name of Assignee)

whose full post office address is P. O. Box 1431
Duncan, Oklahoma 73536 U.S.A.

all my/our right, title and interest in Canada in and to my/our invention relating to

"Downhole Tool Apparatus With Non-Metallic Components and Methods of Drilling Thereof"
(title of invention)

as fully described and claimed in the application for a patent for such invention and to all my/our corresponding right, title and interest in and to any patent which may issue therefor.

SIGNED at Duncan, Oklahoma U.S.A.
(city or town) (country)

this 8th day of July, 1992.

Steven G. Streich
Donald F. Hushbeck
Kevin T. Berscheidt
Rick D. Jacobi
(Signature of Assignor/s)

I, Jo Ann Goodwin (name of Witness) declare that I was personally present and did see Steven G. Streich, Donald F. Hushbeck, Kevin T. Berscheidt, and Rick D. Jacobi (name of Assignor/s) duly sign and execute the above assignment.

Jo Ann Goodwin
(signature of witness)

2071781 20050

Consumer and Corporate Affairs Canada | Consommation et Corporations Canada

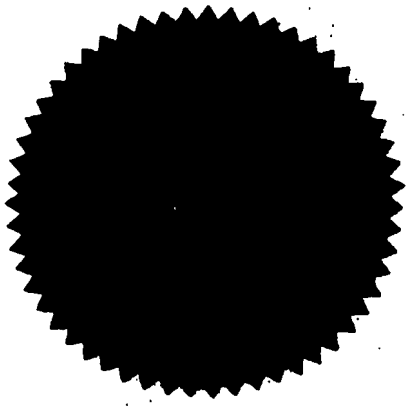
Patent Office | Bureau des brevets

REGISTRATION — ENREGISTREMENT

1350320

APPLICATION — DEMANDE | PATENT — BREVET

2071721



Registered at the Patent Office at Hull, Canada.
Enregistré au bureau des brevets, à Hull, Canada.

FEB 19 1993

As witness the Seal of the Patent Office.
Comme en fait foi le sceau du bureau des brevets.

N. BÉDARD

CCA-238 (04-89) 41

Canada

Consommation et Corporations Canada
Consumer and Corporate Affairs Canada

Bureau des brevets
Patent Office

Ottawa, Canada
K1A 0C9

Swabey Ogilvy Renault
1001 boul. de Maisonneuve ouest,
Suite 800,
Montreal, Quebec
H3A 3C8

Your File
5059-598

FILING CERTIFICATE

Patent File No: 2,071,721-1 **Filed:** 1992/06/19

Laid-Open Date: 1992/12/22

Priority Date : U.S.A. (719,740) 19910621

Invention : Downhole Tool Apparatus with Non-Metallic Components and Methods of Drilling Thereof

Owner(s) : Streich, Steven G.; Hushbeck, Donald F.; Berscheidt, Kevin T.; Jacobi, Rick D.

Inventor(s) : Same as owner

FILED 2071721

SPECIAL NOTICE

You are reminded that annual fees to maintain your application (or patent) are needed for each one-year period between the 1st and 19th anniversaries of the filing date. Failure to pay will lead to abandonment of your application (or lapsing of a patent).

A. McDonough

DIRECTOR
DOCUMENTATION AND
REGISTRATION BRANCH

Canada